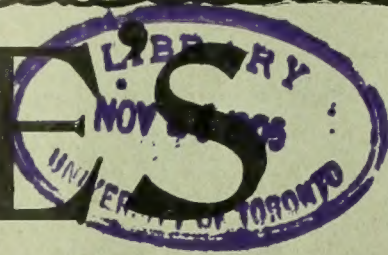


PAGE'S WEEKLY



ENGINEERING · ELECTRICITY
SHIPBUILDING & MINING
IRON & STEEL INDUSTRIES

EDITORIAL & PUBLISHING OFFICES, CLUN HOUSE, SURREY STREET, STRAND, LONDON, W.C.

FRANCE, Paris : 22, Rue de la Banque.
GERMANY, Berlin : 13, Unter den Linden.
RUSSIA, St. Petersburg : 14, Nevsky Prospect.
ITALY, Rome : 307 Corso.
AUSTRIA, Vienna : Kärntnerstrasse, nr. 30.

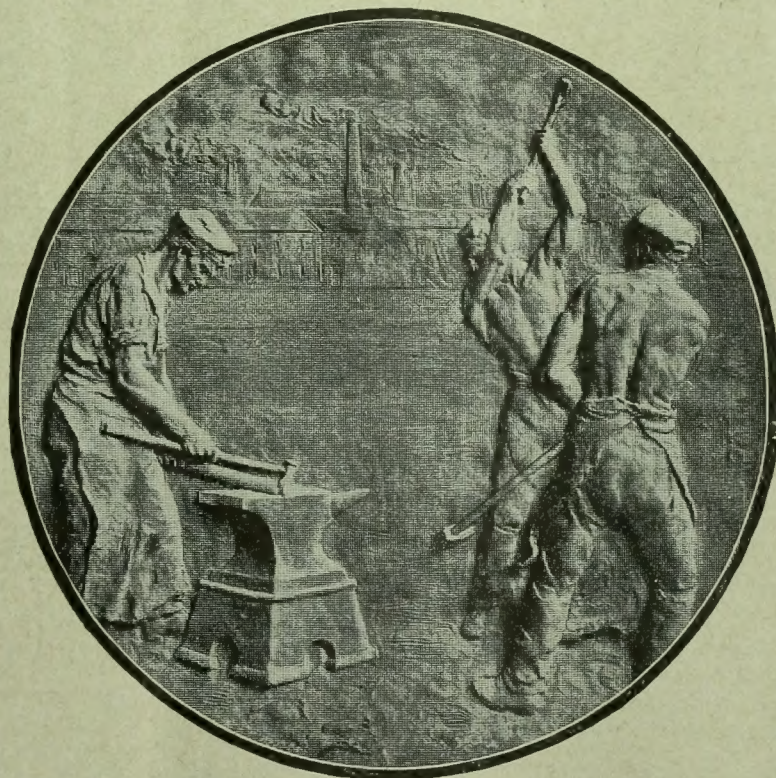
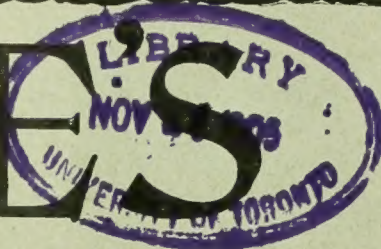
INDIA, Calcutta : Thacker, Spink & Co.
Bombay : Thacker & Co., Ltd.
SOUTH AFRICA, Cape Town : Gordon & Gotch.
JAPAN, Yokohama : Kelly & Walsh, Ltd.
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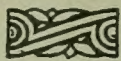
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UNITED STATES, New York : International News Co.
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PAGE'S WEEKLY



ENGINEERING · ELECTRICITY
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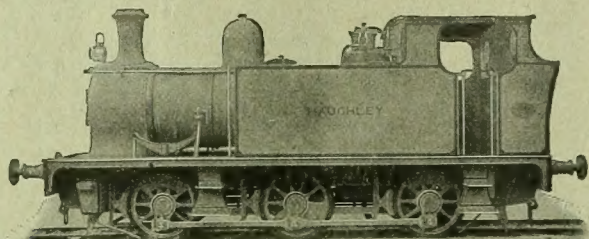
TEL. ADDRESS: "LOCO., LEEDS."

HUDSWELL, CLARKE & Co.,

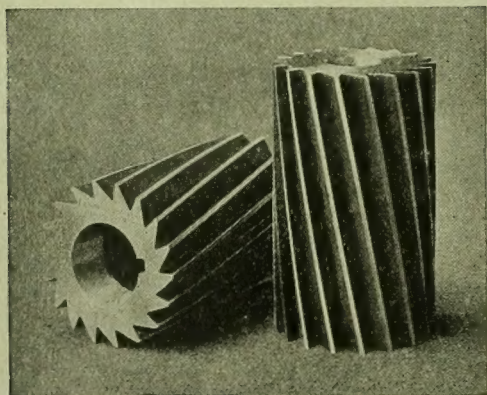
RAILWAY FOUNDRY LEEDS. **LTD.**

LOCOMOTIVE ENGINES,

Of all sizes and any gauge of Railway, of greatly improved Construction, for Main or Branch Railways, Contractors, Ironworks, Collieries. Prices, Photographs, and full Specifications on application.



SOLE MAKERS OF THE "RODGERS" PULLEYS (Registered).
 Wrought Iron throughout, Rim, Arms, and Boss.
 ALSO "ETCHELLS'" NON-DRIP BEARINGS, SHAFTING, AND ACCESSORIES.



MILLING CUTTERS.

High Speed
 or * *
 Ordinary Steel.

E. G. WRIGLEY & CO., Ltd.,
 Foundry Lane Works,
SOHO, BIRMINGHAM.

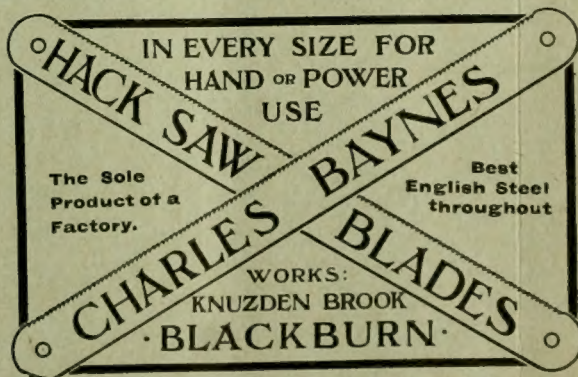
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FOR NOISELESS MOTOR DRIVES.

MACHINE-CUT GEARS

OF ALL DESCRIPTIONS.

THE REID GEAR CO.,
 Linwood, PAISLEY.



PAGE'S WEEKLY

Miscellaneous

Mr. G. H. HUGHES, M.I.Mech.E.,

Consulting and Organising Engineer for Water Works and Industrial Undertakings,

19, OLD QUEEN ST., WESTMINSTER, S.W.

Telephone No.: 5754 Bank.

Write for particulars.

A. MOUNT-HAES,

M.I.Mech.E., M.I.M.E.,

Consulting and Mining Engineer for Ore Dressing Plants of All Classes.

11, IRONMONGER LANE, LONDON. E.C.

Tel. Address: "DRESSINGS, LONDON." Telephone No.: 272 Central.

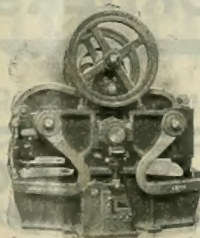
NEW BOILERS

READY FOR PROMPT DELIVERY.

	Size.	Working Pressure.
One Thompson Boiler,	30 ft. by 8 ft. 6 in.	for 160 lb.
Three "	30 ft. " 8 ft. 6 in.	" 120 lb.
One "	30 ft. " 8 ft. 6 in.	" 100 lb.
Three "	30 ft. " 8 ft.	" 120 lb.
Six "	30 ft. " 8 ft.	" 100 lb.
One "	28 ft. " 7 ft.	" 140 lb.
One Cornish "	20 ft. " 5 ft.	" 100 lb.

All sizes of Vertical Boilers from 2 to 20 n.h.p.

JOHN THOMPSON, Wolverhampton.



PUNCHING & SHEARING Machines.
STEAM HAMMERS.

Shipbuilders' MACHINE TOOLS.

DAVIS & PRIMROSE,

Leith Ironworks, EDINBURGH.

TRANSPORTERS.

See our Advertisement appearing Nov. 24th.

TEMPERLEY TRANSPORTER CO.,

72, Bishopsgate Street Within, LONDON, E.C.

Telephone: 365 London Wall.

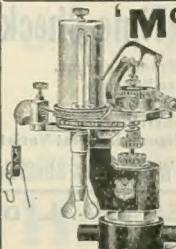
Telegrams: "Transumo."

PAGE & ROWLINGSON, Chartered Patent Agents.

Handbook of Information Free.

28, NEW BRIDGE STREET, LONDON, E.C.,

And 14, St. Ann's Square, Manchester.



'MCINNES-DOBBIE' INDICATORS.

In Two types: External and Enclosed Pressure Springs.

Each made in several forms and sizes to suit all speeds and pressures.

Special Indicators for Gas, Winding, and Ammonia Engines, and for Motor-Cars.

DOBBIE, MCINNES, LIMITED,

Adopted by the British, French, and Japanese Admiralties.

45, BOTHWELL ST., GLASGOW.

BABCOCK & WILCOX, Ltd.

PATENT WATER-TUBE BOILERS.

These Boilers are in use throughout the world to the extent of 4,700,000 h.p. generating steam for all purposes, and fired with all kinds of fuel.

See our Advertisement appearing Nov. 24th. page 37.

HEAD OFFICES—Oriel House, Farringdon Street, LONDON, E.C.

WORKS—Renfrew, SCOTLAND.

WAYGOOD LIFTS

APPLY FOR CATALOGUE.

FALMOUTH ROAD, LONDON, S.E.

HEAD, WRIGHTSON & CO., LTD.,

STOCKTON-ON-TEES,

for all kinds of

Colliery Plant & Mining Machinery.

M. GLOVER & CO., LEEDS,

SAW MILL ENGINEERS.

"IDEAL" GUARDS, BENCHES, SHARPENERS, FIREWOOD, and LIGHTER PLANTS,

Saving in Wages alone means

A CERTAIN LARGE INCOME.



Standard of the World.

J. H. WILLIAMS & CO.,

Drop-forgings only.

Brooklyn, New York

PAGE'S WEEKLY

Miscellaneous

It is not only in America that engineers need to organise an efficient advertising campaign. The necessity is as great, or more so, on this side. To meet such conditions the British Advertiser Service Bureau, of Queen Anne's Chambers, Westminster, specialises in advertising for engineers. They undertake to conduct a firm's advertising in the same way as would a department of the concern. They prepare copy, draft booklets, circulars, &c., but differ from an advertising agency in the important feature that they do no placing; rendering only service for which they are paid by the advertiser, they leave the actual purchasing of space and printed matter in the client's hands. Several large engineering concerns have already availed themselves of the facilities thus afforded, and others have signified their intention of doing so when existing arrangements expire.



Brass Labels & Time Checks

Marks, Name Stamps, Branding Irons,
Sets of Letter and Figure Punches,
Embossing Presses and Dies, Seals,
Brass Name Plates, Stencil Plates,
Moulders' Letters and Figures in Great Variety.

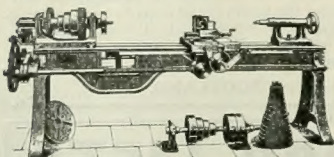
ED. PRYOR & SON, 68, West Street, Sheffield.

BRETT'S PATENT LIFTER CO., LTD.,
COVENTRY, ENG.

Speciality—

FORGING PLANT.

See our Advertisement appearing Nov. 24th.
SEND FOR LATEST CATALOGUE.



HIGH-CLASS MACHINE TOOLS

In stock for immediate delivery.

THOS. W. WARD, L^D.
Albion Works,
SHEFFIELD.



A NEW GAUGE CLASS.

Samples, Lists, and
Testimonials on application

"S.H.P."

Tested to
350 lb. Steam
Pressure. For High Pressure
Boilers.

WALTER SCOTT, LTD.,

LEEDS STEEL
WORKS, LEEDS,
ENGLAND.

MANUFACTURERS OF . . .

Rolled Steel Joists, Channels, etc.

Mild Steel Blooms, Billets, Slabs, Tinbars, Rounds and Flats.

Speciality: **TRAMRAILS.**



Rochester Card
Bundy Key
Signature
Journey
Speed

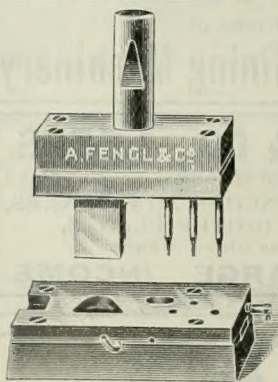
RECORDERS.

For further particulars
.. of our . .

see our whole page Ad. on Nov. 24th.

TIME RECORDERS

RECORDERS, LTD., 171, Queen Victoria Street, LONDON, E.C.



DO YOU WANT ANY Press Tools, Jigs, Cutters, Rimers, Gauges?

If so, send your requirements, and

A. FENGL & CO.,
ALTRINCHAM,

will submit design and price.

Inventors' Models Worked Out
and Manufactured.

STAMPINGS TO THE TRADE.
Telegrams: "Fengl, Altrincham."

WEST PASCAGOULA CREOSOTING WORKS,

WEST PASCAGOULA, MISS., U.S.A.

Situated on Pascagoula Bay and on the line of the Louisville and Nashville Railroad. These works have been in operation for more than twenty-six years. ORDERS for Creosoted Piles, Telegraph Poles, Cross Arms, Electric Conduits, Paving Blocks, Sawed Tiles, and Timber PROMPTLY EXECUTED. New cylinders, 115 ft. long. Capacity, one million feet per month. A.B.C. Code used. Cable address: Pierre, West Pascagoula, Miss.—Address, JNO. B. LINDSEY, Superintendent.

J. FREDK. MELLING,

14, Park Row, LEEDS, ENGLAND.

Iron & Steel Bars, Plates, Sheets,
Girders, Channels, Angles, Rails,
Blooms, Billets, & Slabs.

Write for
Section Lists
and Prices.

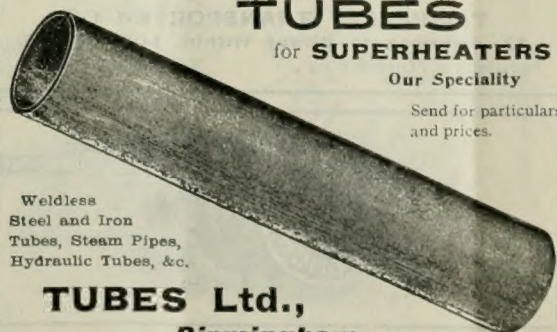
Telegrams: "LEGATION, LEEDS."

TUBES

for **SUPERHEATERS**

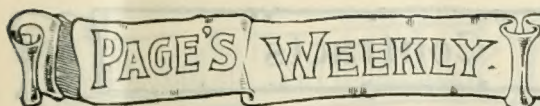
Our Speciality

Send for particulars
and prices.



Weldless
Steel and Iron
Tubes, Steam Pipes,
Hydraulic Tubes, &c.

TUBES Ltd.,
Birmingham.



Miscellaneous

"ZECO" Brand. Blue Planished and Glazed Steel Sheets for Lagging and Covering generally.

ZEITZ & Co., 27, Lime St., London, E.C.

INSULATORS.

VARNISH **CLOTH**

TELEGRAMS "EBONESTOS" LONDON. TELEPHONE No 1422 HOLBORN.

EBONESTOS MFG. CO.
22 ROSMAN ST
CLERKENWELL
LONDON, E.C.

PRICE & PARTICULARS E.C. LISTS ON APPLICATION.

INSULATORS.

RIVETS, BOLTS, & SCREWS

Of all Descriptions and for all Purposes.

SEND FOR CATALOGUE.

T. D. ROBINSON & CO., Ltd.,
DERBY.

Refuse Destructors.

Write for particulars to:-

HEENAN & FROUDE, LIMITED,
4, Chapel Walks, MANCHESTER.

Works: MANCHESTER and WORCESTER.

Hack Saw Blades

"H. G. T."

(High Grade Throughout.)

Proved **BEST** by Independent **TEST.**

Lists and Samples Free.

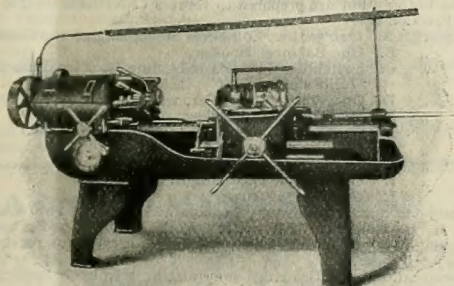
BEANLAND, PERKIN & Co.,
2 to 8, Neville Street, LEEDS.

Riveted & Welded Steel Pipes.

THOMAS PIGGOTT & CO., LTD., SPRING HILL, BIRMINGHAM.

Send for Estimates.

HARTNESS FLAT TURRET LATHE



The only Turret Lathe with Cross Sliding Head.

JONES & LAMSON MACHINE CO.,
"JUBILEE BUILDINGS,"
97, Queen Victoria Street, LONDON.

SHONE PNEUMATIC EJECTORS

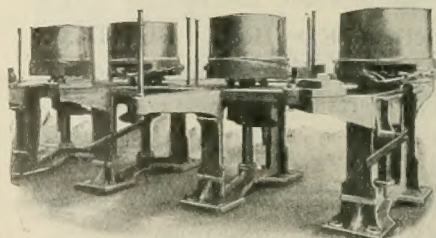
FOR RAISING SEWAGE, SLUDGE, WATER, &c.

Air Compressing Machinery
FOR ALL SERVICES.

HUGHES & LANCASTER

16, VICTORIA STREET, LONDON, S.W.

ED. BRAND, 35, Shakespeare St., MANCHESTER.



INQUIRIES
SOLICITED

Telegraphic
Address:
"Filières,
Manchester."

Wire-Drawing
Blocks for all
kinds of Metal.

MODERN WIRE-WORKING MACHINERY,

Wire-Weaving Power Looms, Netting Machinery, Complete Machinery for Electrical Wire, Wire Rope and Wire Testing Machinery.

PAGE'S WEEKLY

Contracts

CONTRACTS.

BURY AND DISTRICT JOINT WATER BOARD.

TENDERS FOR CAST-IRON PIPES.

The Board invite TENDERS for the SUPPLY and DELIVERY of 3,000 yards (74 tons) of 4-in. diameter CAST-IRON TURNED and BORED PIPES.

Specification and Form of Tender may be obtained from the Engineer to the Board, Mr. J. CARTWRIGHT, Peel Chambers, Market Place, Bury, Lancs., on payment of £1, which amount will be returned on receipt of a *bona fide* Tender.

Tenders, sealed and marked "Tender for Cast-Iron Pipes," are to be delivered to the undersigned not later than Wednesday, November 15th, next.

Bank Street, Bury,
October 10th, 1905.

JOHN HASLAM,
Clerk to the Board.

GREAT YARMOUTH UNION.—THE

Great Yarmouth Board of Guardians are prepared to receive TENDERS for the following:—

CONTRACT NO. 1.—TWO STEEL LANCASHIRE BOILERS.

CONTRACT NO. 3.—ONE SHALLOW WELL.

Specifications and all particulars may be obtained on application to Mr. W. J. CARPENTER, A.M.I.C.E., South Denes Road, Great Yarmouth, on deposit of a cheque for £1 1s., returnable on the receipt of a *bona fide* Tender.

Tenders (endorsed) to be addressed to "The Clerk, Great Yarmouth Board of Guardians," Queen Street, Great Yarmouth, and must be received by him through the post on or before noon on the 14th day of November, 1905.

The Great Yarmouth Board of Guardians do not bind themselves to accept the lowest or any Tender.
Great Yarmouth, October 23rd, 1905.

COUNTY OF LONDON.—TO ENGINEERS AND OTHERS.

The London County Council invites TENDERS for the SUPPLY, DELIVERY, and ERECTION of either SIX or TWELVE SELF-DISCHARGING STEEL COAL TRUCKS, of about 5 tons capacity.

Persons desiring to submit Tenders may inspect the Drawings and obtain the Specification, Bill of Quantities, Form of Tender, and other particulars at the County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council the sum of £2.

This amount will, after the Council or its Committee have come to a decision upon the Tenders received, but not before, be returned to the Tenderer, provided he shall have sent in a *bona fide* Tender, and not have withdrawn the same, but in no case will the fee be returned unless a *bona fide* Tender is submitted.

Full particulars of the work may be obtained on application at the County Hall, previously to the payment of the fee for the Specification, etc.

Tenders must be upon the official forms, and the printed instructions contained therein must be strictly complied with.

The contractors will be bound by the contract to pay to all workmen (except a reasonable number of legally bound apprentices) employed by them wages at rates not less and to observe hours of labour not greater than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in and form part of the contract by way of schedule.

Each Tender is to be delivered at the County Hall, in a sealed cover, addressed to the "Clerk of the London County Council, Spring Gardens, S.W.," and marked "Tender for Coal Trucks, Greenwich Generating Station."

No Tender will be received after 10 a.m. on Tuesday, the 14th day of November, 1905.

Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender, and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk to the London County Council.

County Hall, Spring Gardens, S.W.,
October 25th, 1905.

TO CORRUGATED IRON BUILDING MANUFACTURERS.

THE VISITING COMMITTEE of the SALOP and MONTGOMERY ASYLUM invite TENDERS for the ERECTION of a CORRUGATED IRON ISOLATION HOSPITAL on Foundations to be otherwise provided.

Plans and Specification may be obtained at my office on and after October 31st on payment of Two Guineas, which will be returned on receipt of a *bona fide* Tender.

Sealed Tenders, on the form supplied, endorsed "Hospital," must be delivered at my office not later than 10 a.m. on Tuesday, November 14th.

Power is reserved to reject the lowest or any Tender.
A. T. DAVIS, M.Inst.C.E.

Shirehall, Shrewsbury,
October 20th, 1905.

WALLASEY URBAN DISTRICT COUNCIL.

TRAMWAYS DEPARTMENT. CONTRACT FOR STORES.

The Wallasey Urban District Council are prepared to receive TENDERS for the SUPPLY over a period of Twelve Months from the 31st December next of the following STORES, to be delivered at the Tramway Depot, Sea View Road, Liscard, Cheshire—viz.:—

Axles, Steel Car.
Bearings, Armature.
Brake Blocks.
Cloths, White Cotton Cleaning.
Grease, Motor or Axle.
Gear Wheels.
Metal, White Anti-Friction.
Oil, Cleaning.
" Lubricating.
" Paraffin.
Pinions.
Trolley Heads complete and Spare Parts.
Waste, White Cotton.
Wheels, Chilled-Iron Car.
" Steel-Tyred Car.

Further particulars, with Form of Tender, may be had and Samples inspected on application to the General Manager of the Tramways at his office, Sea View Road, Liscard, Cheshire.

Sealed Tenders, which must be on the printed form, endorsed "Tender for Tramway Stores," and addressed to the undersigned, to be delivered per post at my office as below not later than the morning of November 15th next.

The Contractors will be required to enter into a formal contract.
The Council reserve the right to accept the whole or part of a Tender, and do not bind themselves to accept the lowest or any Tender.

By order,
H. W. COOK,
Clerk and Solicitor.

Public Offices, Egremont, Cheshire,
October 27th, 1905.

TO ENGINEERS.

WATERWORKS PUMPING PLANT.

THE WIDNES CORPORATION INVITE

TENDERS for the SUPPLY and ERECTION of a TRIPLE-EXPANSION ENGINE, with 20 in. deep Borehole and Force Pumps capable of discharging three million gallons per diem against a total head of 500 ft.

Copies of General Specification, Conditions, and Plans may be had on application to ISAAC CARR, M.Inst.C.E., Widnes, on payment of Two Guineas, which will be returned on receipt of a *bona fide* Tender.

Tenders, addressed to the Chairman of the Water Committee, and endorsed "Pumping Engine," must be delivered at the Town Hall, Widnes, on or before noon on Tuesday, December 5th, 1905.

By order,
H. S. OPPENHEIM,

Widnes, November 1st, 1905.

Town Clerk.

BOROUGH OF BARROW-IN-FURNESS.

ELECTRICITY DEPARTMENT.

CONTRACT NO. 16.

The Corporation are prepared to receive TENDERS for the Supply and Erection of—

- Section A. One 500 kw. Combined Steam Engine and Generator.
- " B. One Balancer Booster.
- " C. Switchboard Panels and Connections for Generator and Booster.
- " D. One Water-tube Boiler, with Superheater.
- " E. One Mechanical Stoker.
- " F. Steam and Exhaust Pipes, Valves, &c.
- " G. One Economiser.
- " H. Ironwork.
- " I. One 15-Ton Travelling Crane.
- " J. One Cooling Tower.

Complete Specifications may be obtained after the 23rd inst. from Mr. H. K. BURNETT, Electricity Works, Barrow-in-Furness, on payment of One Guinea, which will be returned upon receipt of a *bona fide* Tender.

Specifications and Drawings may also be seen upon application at the Electricity Works.

Sealed Tenders, endorsed "Contract No. 16, Section.....," to be addressed to the Chairman, Electricity Committee, and delivered at my office not later than 12 noon on Monday, November 13th, 1905.

The Corporation do not bind themselves to accept the lowest or any Tender.

By order,
C. F. PRESTON,
Town Clerk.

Town Hall, Barrow-in-Furness.

PAGE'S WEEKLY

Contracts and Appointments Open

ASHFORD (KENT) URBAN DISTRICT COUNCIL.

TO IRONFOUNDERS AND OTHERS.

The Council is prepared to receive TENDERS for CAST-IRON WATER-PIPES from 9 in. to 2 in. in diameter (about 270 tons), and SPECIAL CASTINGS and SLUICE VALVES, in accordance with Specification, Schedule of Quantities, and Form of Tender, copies of which may be obtained at the Surveyor's Office upon payment of One Guinea, which will be returned upon receipt of a *bona fide* Tender.

Sealed Tenders, endorsed "Cast-Iron Pipes and Valves," to be delivered to Mr. JOHN CREERY (So icitor), Clerk to the Council, 11, Bank Street, Ashford, Kent, not later than 5 p.m., November 16th next. The Council does not bind itself to accept the lowest or any Tender.

WM. TERRILL,

5, North Street, Ashford, Kent,
October 30th, 1905.

Surveyor.

THAMES CONSERVANCY.—CONTRACTS FOR STORES.

The Conservators of the River Thames invite TENDERS for the SUPPLY of MATERIALS and STORES, including:—

Ropes, Lines, &c.
Wrought Iron and Steel.
Rivets, Bolts, Nuts, &c.
Nails, Spikes and Ironmongery.
Brooms, Brushes, &c.
Paints and Varnishes.
Oils, &c.
Asbestos, Packing, and India-rubber.
Cotton Waste, &c.
Timber.
Portland Cement.

To be delivered as required at the Conservancy Works, Port of London Wharf, Millwall; Strand-on-the-Green, Chiswick; or Caversham Lock, Reading.

Specifications and Forms of Tender may be obtained at the Conservator's Offices, Victoria Embankment, E.C., on and after Wednesday, the 8th November, 1905.

Tenders must be sent in to me not later than Saturday, the 18th November, 1905.

The Conservators do not bind themselves to accept the lowest or any Tender.

ROBERT PHILIPSON,
Secretary.

Thames Conservancy Offices,
Victoria Embankment, London, E.C.
November 3rd, 1905.

URBAN DISTRICT OF FINCHLEY.

The COUNCIL of the above-named District are prepared to receive TENDERS for the SUPPLY, DELIVERY, and FIXING of UNDERGROUND PUMPING MACHINERY to raise 9,200 gallons of Sewage per hour through a 6-in. Rising Main to an approximate height of 61 ft., the machinery to have automatic starting and stopping gear.

The Motor is to be wound for a speed of 600 revolutions per minute, the voltage of continuous supply being 500 volts. The Rising Main and Underground Chamber will be provided by the Council.

Each Tender must be accompanied by a Design and large-scale fully dimensioned Drawing, together with a full description of the whole of the Works.

Copy Specification may be obtained from the Engineer and Surveyor to the Council on application at the unmentioned offices, accompanied with a deposit of £1, which will be refunded on receipt of a *bona fide* Tender together with accompanying documents.

The Council do not bind themselves to accept the lowest or any Tender.

Sealed Tenders, endorsed "Underground Pump," and addressed to me, to be sent in by not later than 5 o'clock on Friday, November 24th next.

E. H. LISTER,
Clerk to the Council.

Council Offices, Finchley, N.,
October 25th, 1905.

APPOINTMENTS OPEN.

CITY OF AUCKLAND, NEW ZEALAND.

APPOINTMENT OF CITY ENGINEER.

Applications, accompanied by Testimonials, will be received in the Town Clerk's Office, Auckland, New Zealand, until 4 o'clock p.m. on Thursday, February 8th, 1906, for the appointment of City Engineer to the City of Auckland. Conditions of appointment may be seen, and copies obtained, at the office of the High Commissioner for New Zealand, Westminster Chambers, 13, Victoria Street, London, S.W.

HENRY W. WILSON,

Town Clerk.

September 1st, 1905.

COUNTY BOROUGH OF BOLTON

WATERWORKS DEPARTMENT.
ASSISTANT ENGINEER.

The WATERWORKS COMMITTEE of the BOLTON CORPORATION invite applications for the APPOINTMENT of an ASSISTANT ENGINEER in connection with extensions of their Waterworks Undertaking.

Commencing salary £250 per annum.

Candidates must have had previous practical experience in the construction of reservoirs and works in connection therewith, and be fully competent to prepare the necessary drawings, plans, and sections, and supervise the necessary works of construction.

He will be required to devote the whole of his time to the duties of the office.

Applications, endorsed "Assistant Engineer," stating age, experience, &c., together with copies of not more than three testimonials of recent date, to be delivered to the undersigned on or before the 17th day of November, 1905.

Canvassing members of the Council, either directly or indirectly, will be deemed a disqualification.

SAMUEL PARKER,
Town Clerk.

Town Hall, Bolton.
October 31st, 1905.

BY ORDER OF THE SECRETARY OF STATE FOR INDIA IN COUNCIL.

INDIAN STATE RAILWAYS.

Wanted, for the service of the Government of India, a thoroughly practical man, with up-to-date knowledge, to generally ASSIST the SUPERINTENDENT of the CARRIAGE and WAGON DEPARTMENT of the North-Western Railway of India in the Design and Construction of Railway Carriages and Wagons.

Five years' agreement in the first instance.

Salary to commence at 450 rupees per month, rising by increments of 50 rupees per month yearly to a maximum of 600 rupees per month.

First-class passage out and home.

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Forms of application and further particulars can be obtained by writing to the Director-General of Stores, India Office, Whitehall, London, S.W., not later than November 13th, 1905.

E. GRANT BURLS,
Director-General of Stores.

India Office,
Whitehall, London, S.W.,
October 25th, 1905.

BOROUGH OF IPSWICH.—ENGINEER AND MANAGER OF WATERWORKS.

The Corporation of Ipswich invite APPLICATIONS for the POST of ENGINEER and MANAGER of their Waterworks. The person appointed will be required to take entire charge of the works, pumping station, and reservoirs, design and carry out extensions of mains and plant, and generally superintend the water supply of the town under the directions of the Waterworks Committee. He must devote his whole time to the duties of his office, and not engage in any other occupation.

The salary will commence at £250 per annum.

Applications, with not more than three recent testimonials as to fitness, to be sent to me before Thursday, November 16th, 1905.

Canvassing in any form will disqualify.

WILL. BANTOFT,
Town Clerk.

Town Hall, Ipswich,
October 19th, 1905.

AUCKLAND UNIVERSITY COLLEGE, NEW ZEALAND.

APPLICATIONS are invited for the PROFESSORSHIP of MINING ENGINEERING about to be established at Auckland University College, New Zealand.

Applicants must be qualified to prepare students in the subjects of applied mechanics, mining, and land and mine surveying for the examination of the University of New Zealand required for the degree of Bachelor of Engineering (Mining).

The salary is £500 per annum, in addition to the students' fees, with an engagement for five years. Private practice which did not interfere with the performance of college duties would not be objected to by the College Council.

A suitable allowance will be made for passage money, but not to exceed £100.

The successful applicant must not be over 40 years of age, and must enter upon his duties as soon as possible after January 1st, 1906.

Copies of the questions to be answered by Applicants, the Calendar of the University of New Zealand, and the Form of Agreement to be signed, may be had on application to the High Commissioner for New Zealand, 13, Victoria Street, London, S.W.

BUYERS' DIRECTORY.

NOTE.—The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages 22 and 24.

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. for each additional section.

Advertisers' Service Bureau.

British Advertiser Service Bureau, Queen Anne's Chambers
Westminster, S.W.

Artesian Well Machinery.

John Z. Thom, Patricroft, Manchester.

Band Sawing Machines.

Noble & Lund, Ltd., Felling-on-Tyne.

Bearings (Roller).

Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W.

Beltting.

Binney & Son, Catherine Street, City Road, London, E.C.

Cort, Arthur, & Co., Camberwell, London, S.E.

Fleming, Birky & Goodall, Ltd., West Grove, Halifax.

Gilmour, W. & O., St. John's Hill, Edinburgh.

Boilers.

Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.

Grantham Boiler and Crank Co., Ltd., Grantham.

Hartley & Sugden, Ltd., Halifax.

Thompson, John, Wolverhampton.

Boilers (Water-tube).

Babeock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.

Stirling Boiler Co., Ltd., Motherwell, N.B.

Bolts, Nuts, Rivets, etc.

Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.

T. D. Robinson & Co., Ltd., Derby.

Books.

Griffin, Charles, & Co., Exeter Street, Strand, W.C.

New Zealand Mines Record, Wellington, New Zealand.

Spon, E. & F. N., 125, Strand, W.C.

Boring Machines.

Asquith, William, Ltd., Well Road Works, Halifax.

Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Noble & Lund, Ltd., Felling-on-Tyne.

Case-Hardening Compounds.

Hy. Miller & Co., Millgarth Works, Leeds.

Castings.

Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

Catalogues, Printing, &c.

Atlantic Press, Ltd., Weymouth Street, Manchester.

Spottiswoode Advertising Agency, Clun House, Surrey Street, Strand, W.C.

Stafford, Arthur, & Co., Denton, Manchester.

Chucks.

Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.

Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Clutches (Friction).

David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.

Coke Oven Expert.

Mallmann, P. J., 110-118, Victoria Street, S.W.

Condensing Plant.

Benn, Sykes, Haslingden, near Manchester.

Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.

Mirrlees-Watson & Co., Ltd., Glasgow.

Consulting Engineers.

Gibbs, Juan, & Son, 80, Juke Street, Liverpool.

G. H. Hughes, A.M.I.M.E., 19, Old Queen Street, Westminster, S.W.

Melville & Macalpine, 615, Walnut Street, Philadelphia, Pa., U.S.A.

Mount-Haes, A., M.I.Mech.E., M.I.M.E., 11, Ironmonger Lane, London, E.C.

Continental Railway Arrangements.

Northern Railway of France.

South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.

Adolf Bleichert & Co., Leipzig-Gohlis, Germany.

Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Cooper and Brass.

W. Hepton & Son, Hunslet Lane, Leeds.

Coverings (Boiler).

Magnesia Covering Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.

Joseph Booth & Bros. Ltd, Rodley, Leeds.

Thomas Broadbent & Sons, Ltd., Huddersfield.

Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.

Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).

Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.

E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

Destructors.

Heenan & Froude, 4, Chapel Walks, Manchester.

Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.

Delange & Cie, Mce., Hoboken, near Antwerp.

Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

Drilling Machines.

Asquith, William, Ltd., Well Road Works, Halifax.

Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Noble & Lund, Ltd., Felling-on-Tyne.

Swift, George, Clarence Ironworks, Halifax.

Economisers.

E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).

Hughes & Lancaster, 10, Victoria Street, London, S.W.

Electrical Apparatus.

Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.

British Westinghouse Electric and Manufacturing Co., Ltd., Norfolk

Street, Strand, London, W.C.

Broadbent, T. W., Victoria Electrical Works, Huddersfield.

Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street,

London, S.E.

Ebonestos Manufacturing Co., 22, Rosoman Street, London, E.C.

Gent & Co., Ltd., Faraday Works, Leicester.

Greenwood & Bailey, Ltd., Albion Works, Leeds.

India Rubber, Gutta Percha, and Telegraph Works Co., Ltd.,

Silvertown, London, E.

Matthews & Yates, Ltd., Swinton, Manchester.

Mix and Genest, Berlin, W., Germany.

Nalder Bros. & Thompson, 34, Queen Street, London, E.C.

New Gutta Percha Co., Ltd., Dashwood House, New Broad Street,

E.C.

Newton Brothers, Full Street, Derby.

Phoenix Dynamo Manufacturing Co., Bradford, Yorks.

Scott, E., & Mountain, Ltd., Newcastle-on-Tyne.

Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street,

London, E.C.

Turner, Atherton & Co., Ltd., Denton, Manchester.

B. Weaver & Co. (see Ebonestos Manufacturing Co.), 22, Rosoman

Street, Clerkenwell, London, E.C.

Engineers' Supplies.

Ablers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Engines (Gas).

Campbell Gas Engine Co., Ltd., Halifax.

Cundall, Son & Co., Ltd., Airedale Iron Works, Shipley.

Engines (Electric Lighting).

McLaren, J. and H., Midland Engine Works, Leeds.

Engines (Locomotive).

Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.

Hunslet Engine Co., Ltd., Leeds, England.

Hudswell, Clarke & Co., Ltd., Leeds, England.

McLaren, J. & H., Midland Engine Works, Leeds.

Engines (Stationary).

Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London,

E.C.

Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Mirrlees-Watson Co., Ltd., Glasgow.

Engines (Traction).

Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.

Engravers.

Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

Exhaust Steam Oil Separators.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Fans, Blowers.

Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.

Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast,

Ireland.

Gibbs, John & Son, 80, Juke Street, Liverpool.

Matthews & Yates, Ltd., Swinton, Manchester.

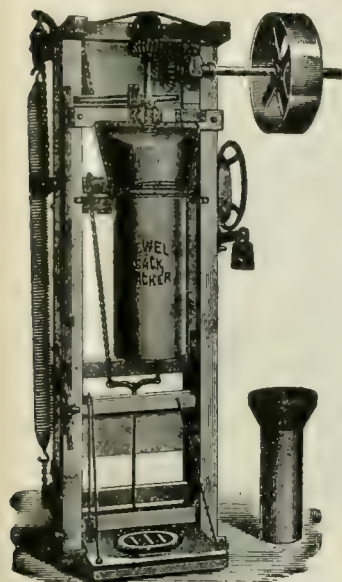
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Fountain Pens.

Mable, Todd & Hard, 93, Cheap side, London E.C.

Forging (Drop) Plants.

Brett's Patent Lifter Co., Ltd., Coventry.

Forgings (Drop).

J. H. Williams & Co., Brooklyn, New York, U.S.A.

Furnaces.

Deighton's Patent Flue & Tube Company, Vulcan Works, Pepper Road, Leeds.
Leeds Forge Co., Ltd., Leeds.

Gauge Glasses.

J. B. Treasure & Co., Vauxhall Road, Liverpool.
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Gauges (Pressure, Vacuum, and Hydraulic).

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Gearing.

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Angus G. & Co., Ltd., Newcastle-on-Tyne.
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Reid Gear Co., Linwood, near Glasgow.
Wild, M. B., & Co., Corporation Street, Birmingham.

Gold Dredging Plant.

Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Greases.

Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Hack Saws.

Baynes, Charles, Knudden Brook, Blackburn.

Hammers (Steam).

Davis & Primrose, Leith Ironworks, Edinburgh.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Hoisting Machinery.

See Conveying Machinery.

Horizontal Boring Machines.

Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Swift, George, Clarence Ironworks, Halifax.

Hydraulic Leather.

Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Hydraulic Machine Tools.

Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Vauxhall and West Hydraulic Engineering Co., Ltd., 23, College Hill, London, E.C.

Icemaking and Refrigerating Machinery.

H. J. West & Co., 114-118, Southwark Bridge Road, London, S.E.

Indicators.

Dobbie McInnes, Ltd., 45, Bothwell Street, Glasgow.
Hannan & Buchanan, 75, Robertson Street, Glasgow.

Iron and Steel.

Allen, Edgar, & Co., Ltd., Imperial Steel Works, Sheffield.
Askham Bros. & Wilson, Ltd., Sheffield.
Fairley & Sons, James, Old Mint, Shadwell Street, Birmingham.
Farnley Iron Co., Ltd., Leeds, England.
Fried. Krupp, Grusonwerk, Magdeburg-Buckau, Germany.
J. Frederick Melling, 14, Park Row, Leeds, England.
Parker Foundry Co., Derby.
Purden, John & Sons, Lambhill Forge, by Maryhill, Glasgow.
Walter Scott, Ltd., Leeds Steel Works, Leeds, England.

Ironwork (Constructional).

F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Ironwork (Galvanised).

F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Lagging Sheets.

Zeitz & Co., 21, Lime Street, London, E.C.

Lathes.

Asquith, William, Ltd., Well Road Works, Halifax.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Eclipse Tool Manufacturing Co., Linwood, near Glasgow.
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Mitchell, D., & Co., Ltd., Parsonage Works, Keighley.
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Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
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Lifts.

Waygood & Co., Ltd., Falmouth Road, London, S.E.

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Matthew Wells & Co., Hardman Street Oil Works, Manchester.

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Batemans Machine Tool Co., Hunslet, Leeds.
Beanland, Perkin, & Co., School Close Works, Leeds.
Bertrams, Ltd., St. Katherine's Works, Sciennes, Edinburgh.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Breuer, Schumacher & Co., Ltd., Kalk, near Cologne-on-Rhine (Germany).
Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.
Cunliffe & Croom, Ltd., Broughton Ironworks, Manchester.
Dean, Smith & Grace, Ltd., Keighley.
Fengl, A., & Co., Grafton Street, Altrincham.
Greenwood & Batley, Ltd., Leeds.
Jones & Lamson Machine Co., 97, Queen Victoria Street, London, E.C.
John Lang & Sons, Johnstone, near Glasgow.
Luke & Spencer, Ltd., Broadheath, Manchester.
Jos. C. Nicholson Tool Co., City Rd. Tool Wks., Newcastle-on-Tyne.
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Noble & Lund, Ltd., Felling-on-Tyne.
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Resides, 12, Aire Street, Brighouse, Yorks.
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Swift, George, Clarence Ironworks, Halifax.
Taylor and Challen, Ltd., Derwent Foundry, Constitution Hill, Birmingham.
Vauxhall and West Hydraulic Engineering Co., Ltd., 23, College Hill, London, E.C.
H. W. Ward & Co., Lionel Street, Birmingham.
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West Hydraulic Engineering Co. (see Vauxhall and West Hydraulic Engineering Co. Ltd.), 23, College Hill, London, E.C.
Winn, Charles & Co., St. Thomas Works, Birmingham.
Yorkshire Machine Tool and Engineering Works, Liversedge, Yorks.

Marks.

Pryor, Edward, & Son, 68, West Street, Sheffield.

Metals.

Delta Metal Co., Ltd., East Greenwich, London, S.E.
Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, 49, Queen Victoria Street, London, E.C.
Phosphor Bronze Co., Ltd., Southwark, London, S.E.

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W. Barns & Son, Chalton Street, Euston Road, London, N.W.
Brown, Andrew, & Co., 110, Cannon Street, London, E.C.
Méguin, Fr., & Co., Ltd., Engineering Works, Dillingen-on-Saar.

Mining Machinery.

Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Office Appliances.

Halden & Co., J., 8, Albert Square, Manchester.
Hall & Co., B. J., 39, Victoria Street, London, S.W.
Inglesant, T., & Sons, Ltd., Atlas House, Leicester.
Lyle Co., Ltd., Harrison Street, Gray's Inn Road, London, W.C.
Rockwell-Wabash Co., Ltd., 69, Milton Street, London, E.C.
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Valor Co., Ltd., Rocky Lane, Aston Cross, Birmingham.

Packing.

Beldam Packing & Rubber Co., 93-94, Gracechurch Street, London, E.C.
Lancaster & Tonge, Ltd., Pendleton, Manchester.
Redfern & Co., S., Swan Lane, New Brown Street, Manchester.
Quaker City Rubber Co., Coronation House, Lloyd's Avenue, E.C.
United States Metallic Packing Co., Ltd., Bradford.
J. Bennett von der Heyde, 6, Brown Street, Manchester.

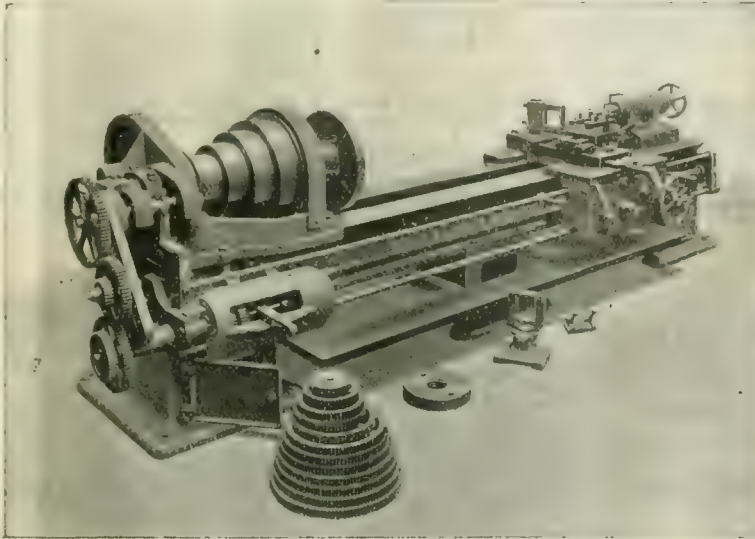
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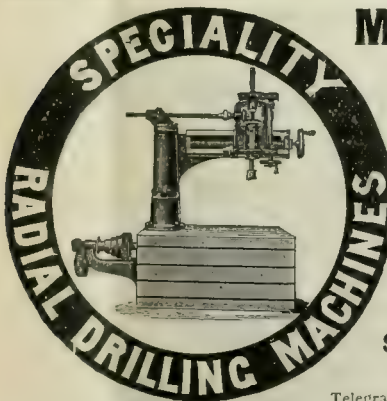
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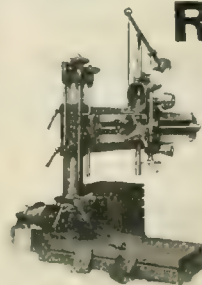
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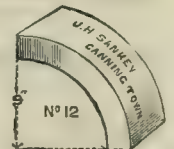
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Photographic Apparatus.

Marion & Co., Ltd., 22 and 23, Soho Square London, W.

Pinch Bars.

Samson & Co., Garforth, near Leeds.

Pipe Wrenches (Chain).

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Pistons.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Planished Sheets.

Zeitz & Co., 21, Lime Street, London, E.C.

Pneumatic Tools.

Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.

Porcelain.

Gustav Richter, Charlottenburg, near Berlin, Germany.

Presses (Hydraulic).

Greenwood & Batley, Albion Works, Leeds
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Publishers.

Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.
Spon, E. and F. N., 125, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.

Pumps and Pumping Machinery.

Drum Engineering Co., 27, Charles Street, Bradford.
Enke, Carl, Schkeuditz-Leipzig, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
J. P. Hall & Sons, Ltd., Peterborough.
Hathorn, Davey & Co., Ltd., Leeds, England.
Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, London, W.C.

Radial Drilling Machines.

Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Mitchell, D., & Co. Ltd., Parsonage Works, Keighley.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
Swift, George, Clarence Ironworks, Halifax.

Rails.

Wm. Firth, Ltd., Leeds.

Riveted Work.

F. A. Keep, Juxon & Co., Forward Works, Barn Street, Birmingham.

Roller Bearings.

Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W.

Roofs.

D. Anderson & Son, Ltd., Lagan Felt Works, Belfast.
Head, Wrightson & Co., Ltd., Thornaby-on-Tees.

Ropeways (Aerial).

Bullivant & Co., Ltd., 72, Mark Lane, London, E.C.

Scientific Instruments.

Cambridge Scientific Instrument Co. Ltd. Cambridge.

Slotting Machines.

Swift, George, Clarence Ironworks, Halifax.

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Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stampings.

Thomas Smith & Sons of Saltley, Ltd., Birmingham.
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

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Lancaster & Tonge, Ltd., Pendleton, Manchester.

Steam Wagons.

Thornycroft & Co., Ltd., J. I., Chiswick, London, W.
Yorkshire Patent Steam Wagon Co., Pepper Road, Hunslet, Leeds.

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Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.

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A. Bolton & Co., 40, Deansgate, Manchester.

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Thomas Piggott & Co., Ltd., Spring Hill, Birmingham.
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S. Howes Co., 64, Mark Lane, London, E.C.

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Hopkinson, J., & Co., Ltd., Britannia Works, Huddersfield.
Hunt & Mitton, Crown Brass Works, Oozells Street North, Birmingham.
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Shaw, Joseph, Albert Works, Huddersfield.
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Matthews & Yates, Ltd., Swinton, Manchester.

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Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

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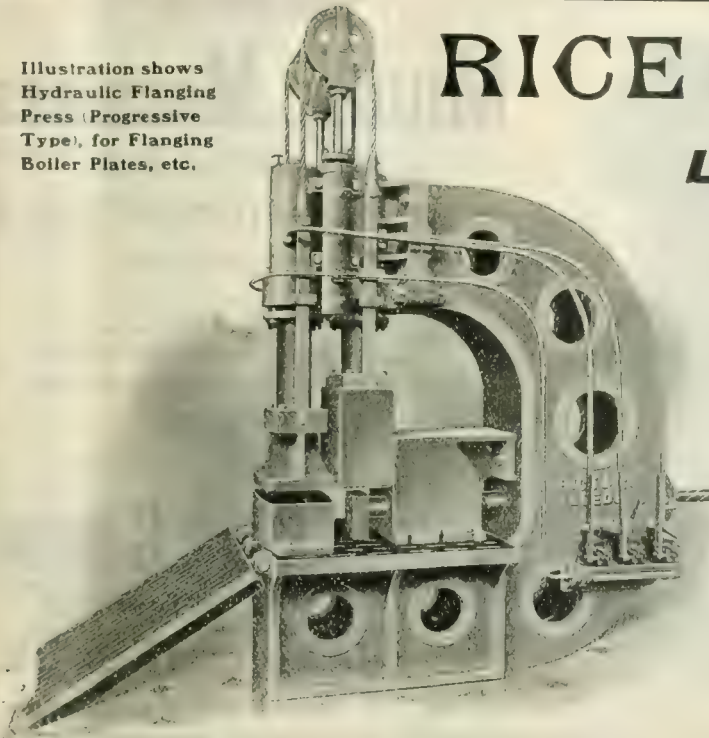
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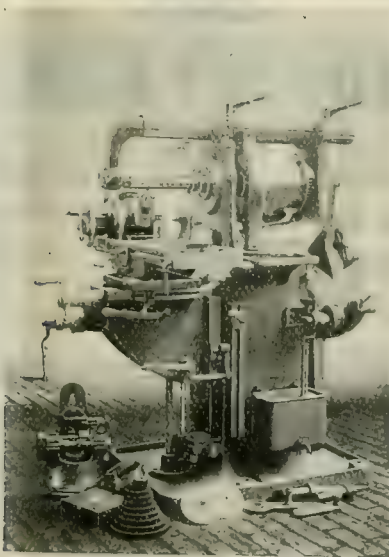


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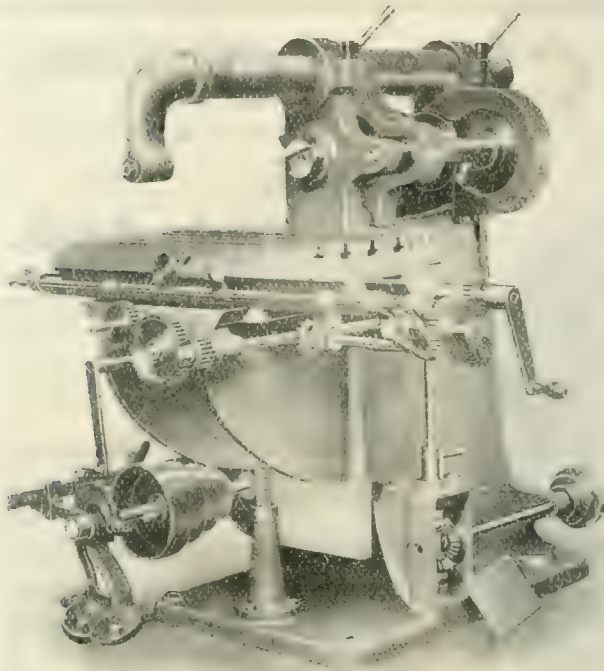
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PAGE'S WEEKLY

Machine Tools



Geared Milling Machines

For Milling at High Speeds
With **RAPID RETURN OF TABLE**

By Rack and Pinion.

Automatic Traverses of Table :—

21 inches transversely.

7½ inches longitudinally.

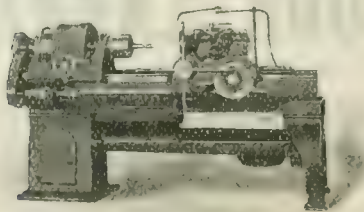
With reverse motions to both feeds.

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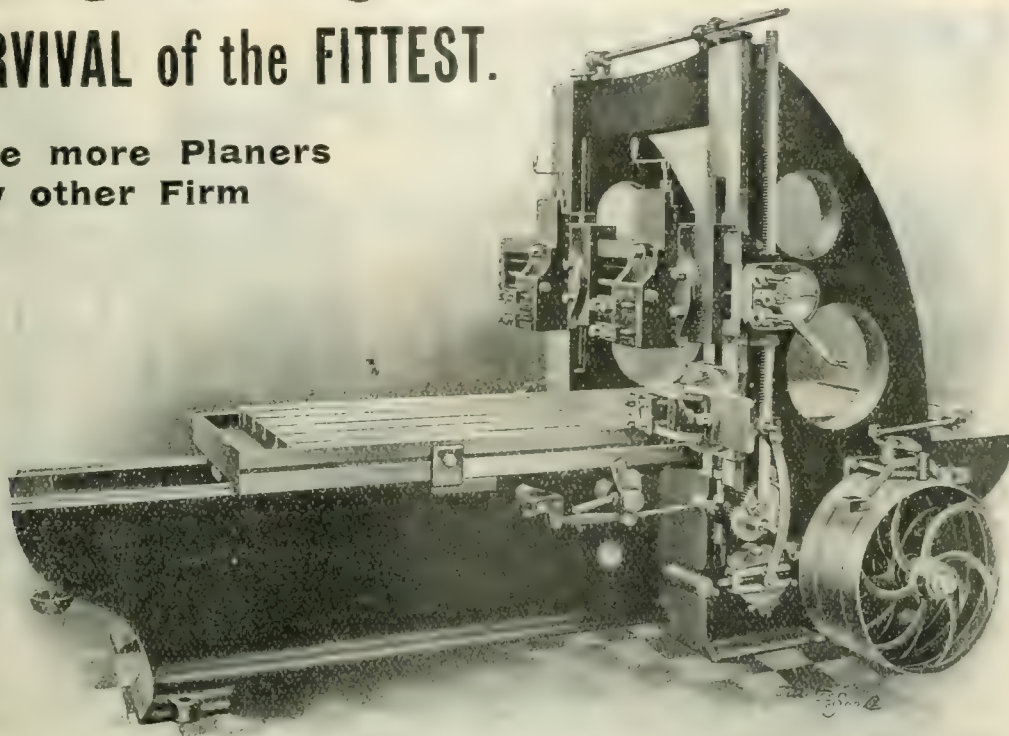
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Our SMALL RADIAL has recently
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Spindle practically equal to sensitive.

Great power and efficiency for

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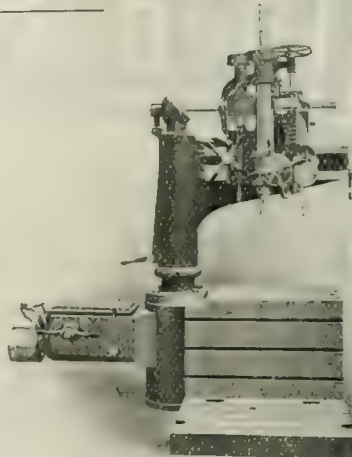
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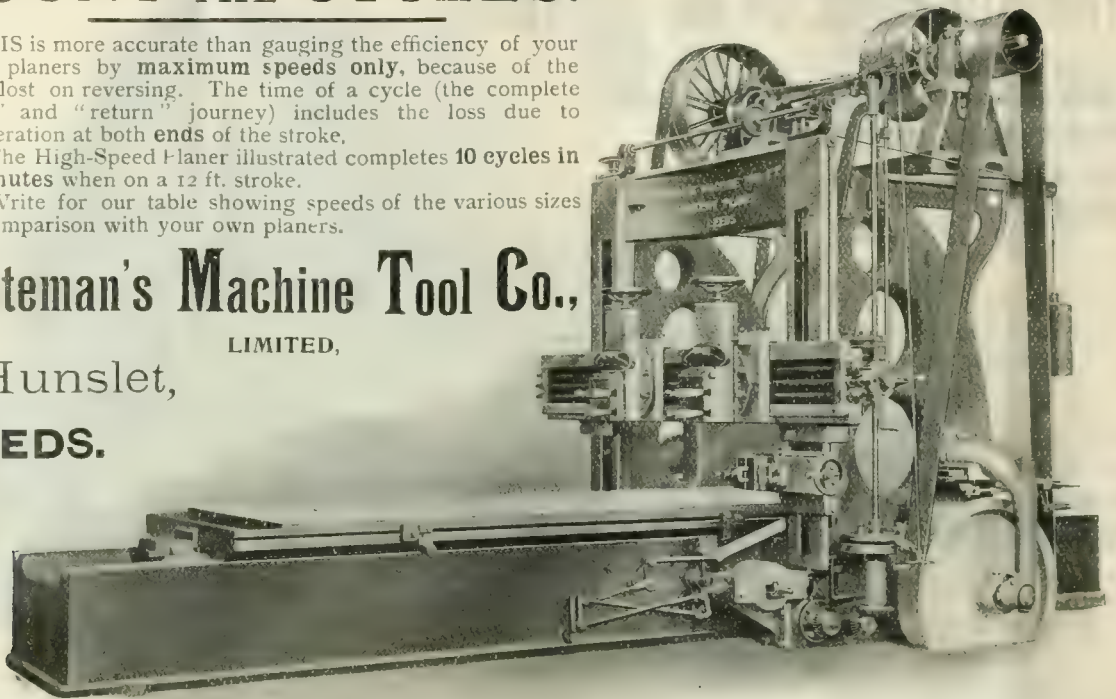
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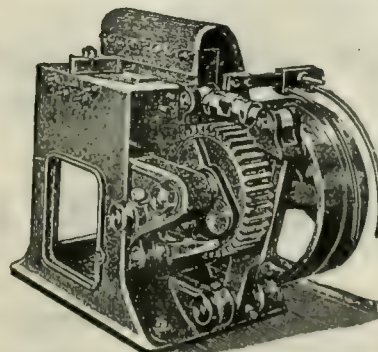
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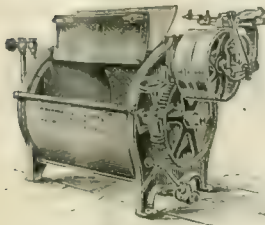
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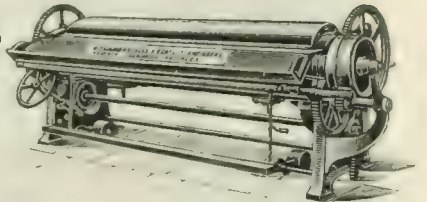
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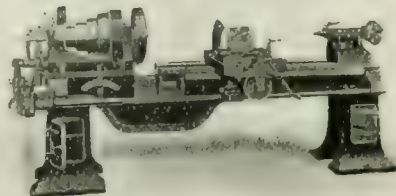
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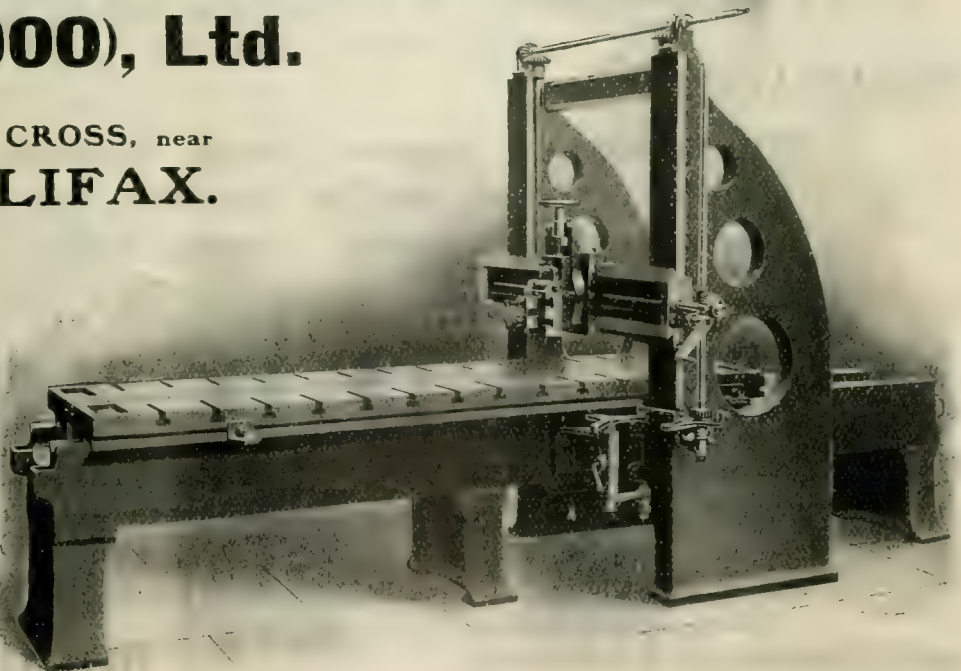
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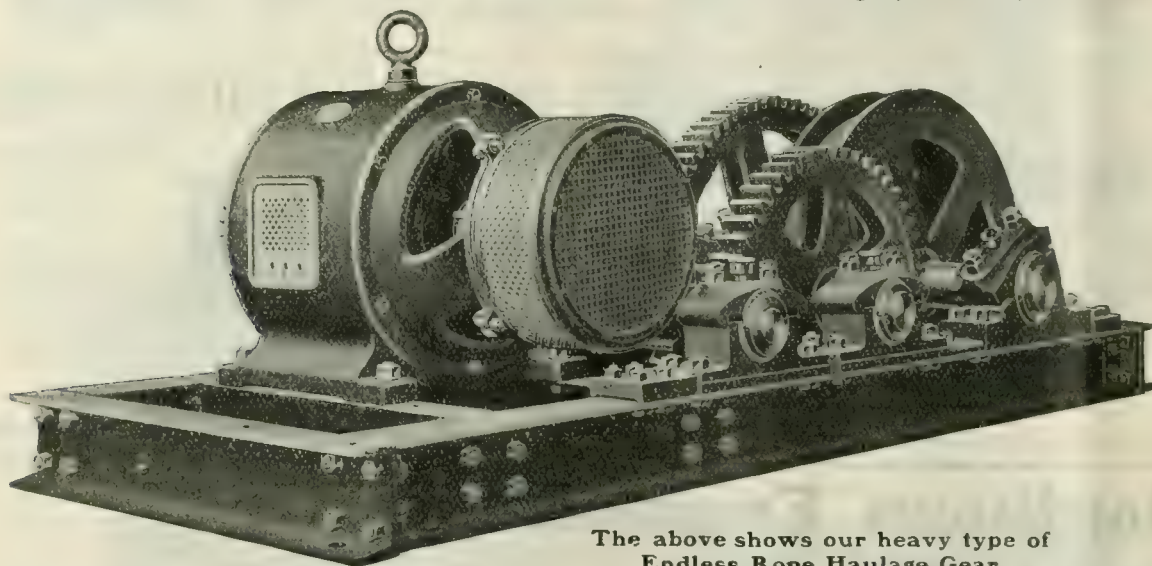
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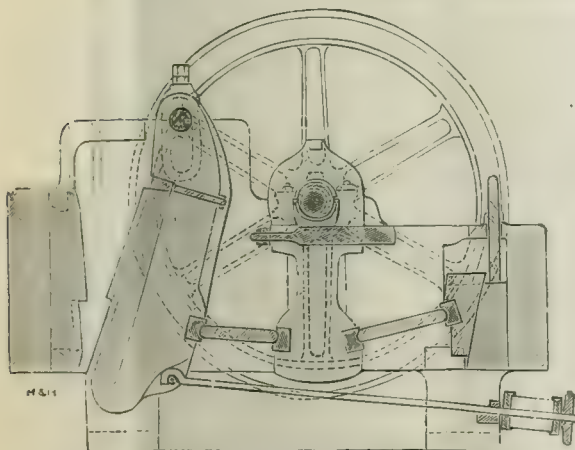
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Section of Machine.

Rollers,
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Made from just such selected hides
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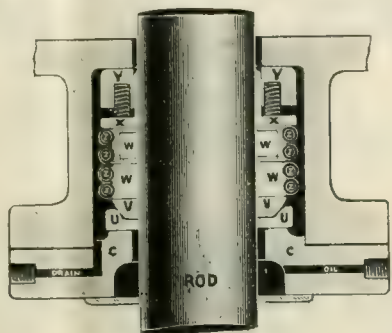
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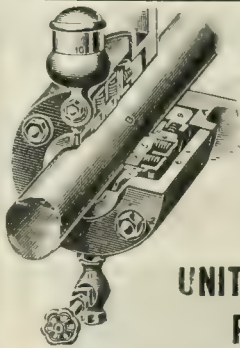
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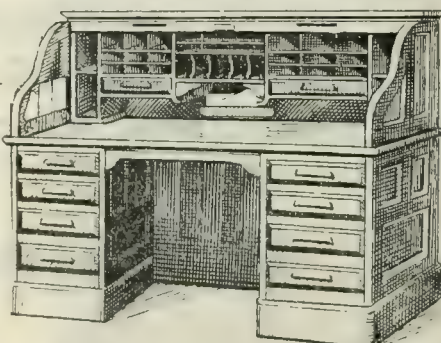
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*Most elegantly designed and finished.
Full of convenient devices other Desks
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THE DESK THAT DELIGHTS.

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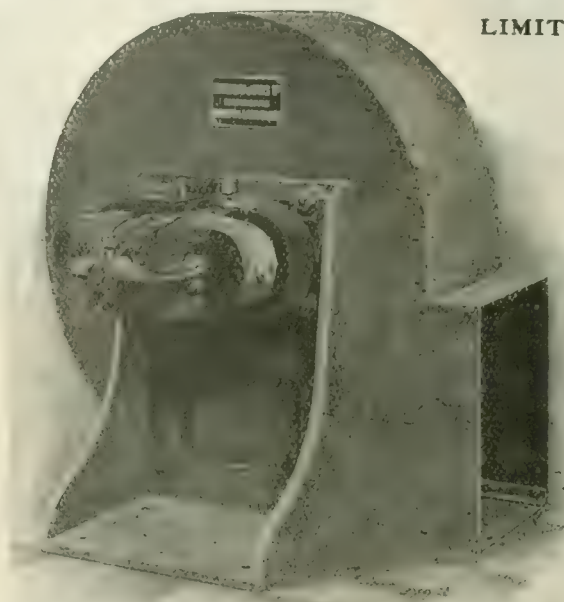
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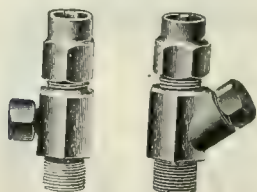
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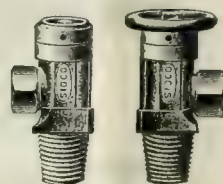
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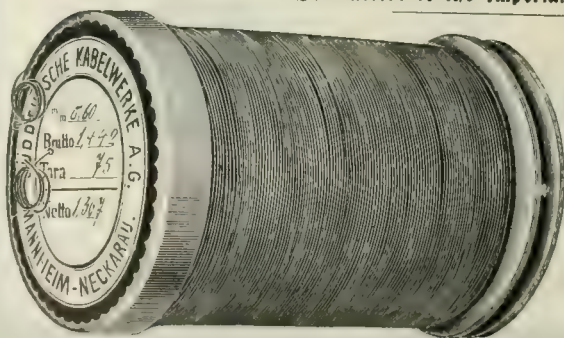
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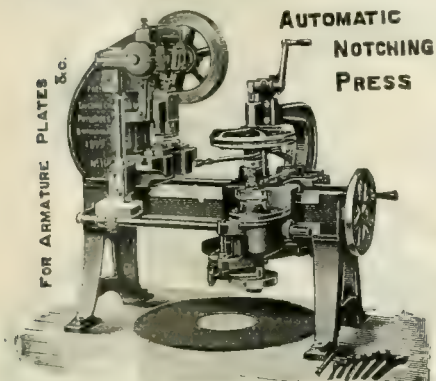
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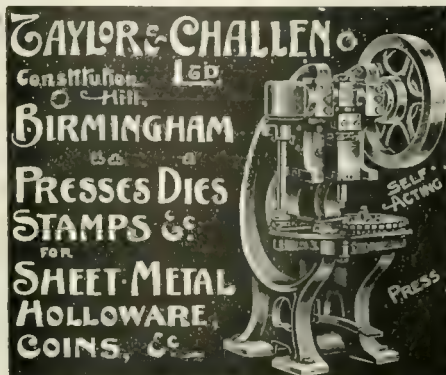
PAGE'S WEEKLY

Miscellaneous

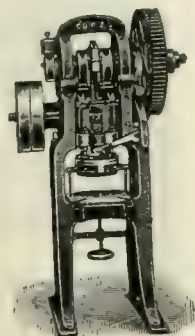


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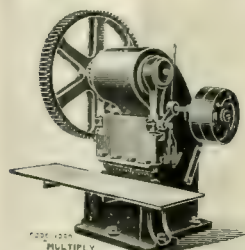


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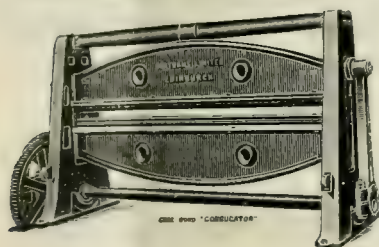
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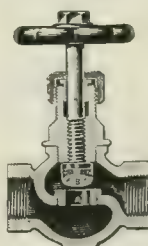
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PAGE'S WEEKLY

Miscellaneous

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**Banish Inkpots and Scratchy Steel
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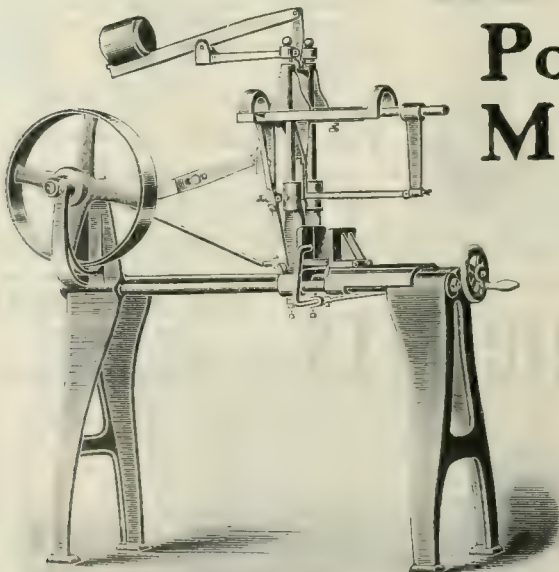
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Power Hack Saw Machine

WITH AUTOMATIC
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THIS machine can be set to stop automatically at any given point by moving the wedge on upright lever up or down. As the machine cuts to a given point the frame strikes this wedge, pushes the lever over until it releases the rod from the clutch on shaft taking into pulley. The falling of this rod releases the clutch, while the driving pulley at once becomes loose and stops the Saw. This enables the operator to set the machine to work, after which it requires no further attention, as it takes care of itself, leaving him free for other work. When the machine saws to the point to which it is set it stops automatically, and is ready for the next cut at the convenience of the operator.

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THE FAIRBANKS COMPANY,

78-80, City Road, LONDON, E.C.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VII.

LONDON, FRIDAY, NOVEMBER 10, 1905.

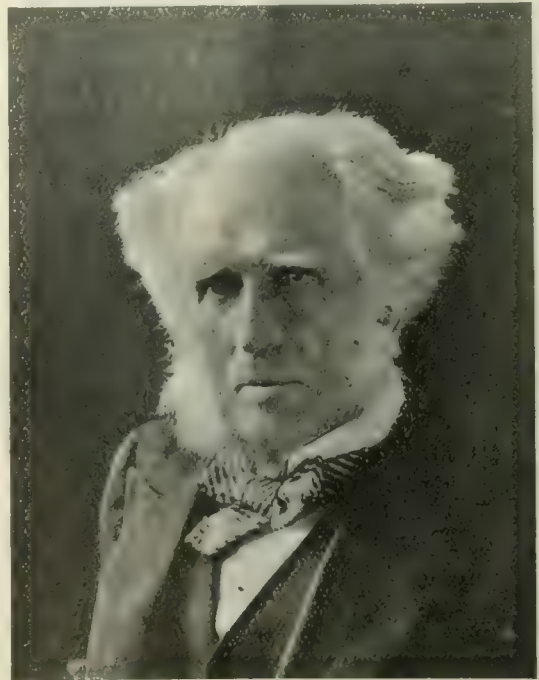
No. 61.

The Offices of "Page's Weekly," Wednesday Evening.

THE announcement that Messrs. Yarrow and Co., Ltd., have decided to transfer their works from the Thames comes as no surprise. The question of removal has been under serious consideration for some long time past, and in deciding to transfer their business to the North of England they are only following a course dictated by circumstances. The main reasons for the impending removal are the high cost of production in London, the intolerable burden of high rates, and the fact that night-work in the Metropolitan district has to be paid for at a higher rate than on the Tyne or the Clyde. This latter fact indeed, as was stated at the time in PAGE'S WEEKLY, was the main reason why Messrs. Yarrow were compelled to decline the offer of a big foreign government contract, the contract price not permitting the payment of time-and-half for night work, which the men demanded. This wages question is probably the most important factor; skilled labour commands from five to fifteen per cent. higher rates in the London district, while the cost of unskilled labour ranges up to 30 per cent. higher.

It is urged, too, by some that the labour in the North of England is, on the whole, more efficient. A great deal turns, no doubt, on the conditions under which the workmen live, and it is held that these, among the Thames men, do

not contribute to the highest efficiency. As stated above this migration is no new thing, a large number of well-known firms having already left the London district for much the same reasons which are impelling the migration of Messrs. Yarrow. To name a few, the Brush Company went to Loughborough; Willans and Robinson, to Rugby; Thornycrofts are



SIR GEORGE BARCLAY BRUCE,
"Father" of the Institution of Civil Engineers, who, as Senior Past-President, on Tuesday proposed the vote of thanks to Sir Guilford Molesworth on his retirement from the Chair.

gradually transferring their work to their Southampton yard; Siemens have migrated to Stafford; Ransomes, to Newark-on-Trent; the Vauxhall Engineering Company, to Luton; Allen's, the well known pump people are now at Bedford; the Pulsometer Company put up works at Reading; whilst on a recent visit to the Garden City, at Letchworth, the writer noticed the names of several well-known manufacturing concerns attached to sites where factories are to be erected.



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"THEY HAVE THEIR EXITS AND THEIR ENTRANCES."

Intending passenger on the Electrified District (inserting himself as the electric train starts).

Is this the Ealing—Guh!—Guh!—Guh! Help! Help!

The above clever drawing represents Mr. Punch's way of dealing with a possible contingency to which we called attention in these columns a few weeks ago.—En.

It has been suggested that the reason for the removal of Messrs. Yarrow's works is an intention on their part to undertake the building of larger vessels such as cruisers and merchant ships. This, however, we are assured, is not the case, as it is Messrs. Yarrow's intention still to confine themselves to the special class of work by which their reputation has been made, viz., torpedo boat destroyers, torpedo boats, specially shallow-draught gun boats, and vessels intended for the pioneer work of commerce. These last-mentioned vessels have successfully opened to commerce shallow rivers in many parts of the world that were hitherto unavailable on account of their small depth of water. It goes without saying that the firm will also continue the manufacture of the Yarrow water-tube boiler. It is understood that no decision has yet been come to as to the site of the new works.

The tube mills ordered by Messrs. H. Eckstein and Co. for the mines under their control last year are now arriving on the Rand, and The South African Mines, Commerce and Industries learns that before the end of the present year they will be at work. On several mines tube mills are already on the ground awaiting installation, whilst nearly all the mines under the control of the Corner House are preparing to put them in. The Robinson Central Deep Company, for instance, is engaged in making foundations for its mills, and hope to have them at work by the middle of December. It is safe to say, adds our contemporary, that early next year these metallurgical innovations will be playing no inconsiderable part in contributing to the output of the Witwatersrand. A London journal recently had an article in which, amongst other detractory statements regarding the Rand, it was said that tube mills had proved themselves to be useless. This pronouncement seems incompatible with the activity that is being displayed all along the reef in equipping mines with these mills.

According to the most recent return the total output of iron ore in the world probably amounted in 1903 to about 100 million tons, the principal producers being the United States, Germany, the United Kingdom, and Spain, in the order given, these countries accounting for about 80 per cent. of the total output. The total quantity of pig iron produced in 1903 probably amounted to about 47 million tons, the principal producers being the United States, Germany, and the United Kingdom, in the order named, the production of the first about equalling the combined output of the next two, and the three countries together accounting for about three-quarters of the total output of the world. The accompanying tables show the output of British iron ore and the production of pig iron for the years 1890 to 1904 inclusive. The same report states that the quantity of steel produced by the open-hearth process in the United Kingdom is at present about double of that produced by the Bessemer process. In Germany, on the other hand, the proportion is reversed, about two-thirds of the total production consisting of Bessemer steel, whilst in the United States also the production of Bessemer steel considerably exceeds that produced by the open-hearth process.

Nearly all the German steel, and the greater part of the steel produced in the United States, is basic steel, the native ores not being for the most part adapted to the acid process. On the other hand for various reasons acid steel is much in demand in this country, and most of the steel produced, whether by the Bessemer or open-hearth process, is acid steel. The large importation of iron ores into this country is determined to a great extent by this demand, the ores raised in the United Kingdom, with the exception of those obtained from Cumberland and Lancashire, being for the most part of a phospheric character and so not available for the acid process.

TABLE I.—IRON ORE.

(a) UNITED KINGDOM.

Year	Production of Iron Ore		Exports of Native Iron Ore	Consumption of Iron Ore			
	Total	Per Head of the Population		Native	Imported (Reports less Re-exports)	Total	Per Head of the Population
	Tons	Tons	Tons	Tons	Tons	Tons	Tons
1890	12,781,000	0.37	8,000	13,773,000	1,432,000	18,205,000	0.49
1891	12,778,000	0.34	25,000	12,765,000	3,164,000	15,919,000	0.42
1892	11,313,000	0.30†	7,000	11,306,000	3,778,000	15,084,000	0.40
1893	11,203,000	0.29	8,000	11,195,000	4,065,000	15,260,000	0.40
1894	12,557,000	0.32	2,000	12,565,000	4,412,000	16,777,000	0.43
1895	12,615,000	0.32	2,000	12,613,000	4,440,000	17,059,000	0.43
1896	13,701,000	0.35	3,800	13,698,000	4,420,000	19,127,000	0.48
1897	13,788,000	0.34	3,000	13,785,000	3,950,000	19,744,000	0.49
1898	14,477,000	0.35	2,000	14,475,000	5,461,000	19,936,000	0.49
1899	14,601,000	0.35	3,000	14,598,000	7,046,000	21,644,000	0.53
1900	14,228,000	0.31	3,000	14,225,000	6,293,000	20,518,000	0.49
1901	12,275,000	0.30	4,000	12,271,000	5,541,000	17,812,000	0.43
1902	13,426,000	0.32	4,000	13,422,000	6,125,000	19,547,000	0.47
1903	13,716,000	0.32	4,000	13,712,000	6,304,000	20,016,000	0.47
1904	13,774,000	0.32	7,000	13,767,000	6,094,000	19,861,000	0.46

TABLE II.—PIG IRON.

Year	Production of Pig Iron		Exports of Pig Iron of Domestic Manufacture	Consumption of Pig Iron.			
	Total	Per Head of the Population		(Of Domestic Manufacture)	Imported (Imports less Re-exports)	Total	Per Head of the Population
	Tons	Tons	Tons	Tons	Tons	Tons	Tons
1890	7,904,000	0.21	1,139,000	6,765,000	60,000	6,825,000	0.18
1891	7,406,000	0.20	837,000	6,569,000	61,000	6,630,000	0.18
1892	6,709,000	0.18	764,000	5,945,000	52,000	5,997,000	0.15
1893	6,977,000	0.18	836,000	6,141,000	32,000	6,173,000	0.16
1894	7,427,000	0.19	826,000	6,601,000	59,000	6,660,000	0.17
1895	7,703,000	0.20	861,000	6,842,000	89,000	6,931,000	0.18
1896	8,660,000	0.22	1,033,000	7,627,000	106,000	7,733,000	0.19
1897	8,706,000	0.22	1,200,000	7,506,000	154,000	7,750,000	0.19
1898	8,610,000	0.21	1,043,000	7,567,000	156,000	7,723,000	0.19
1899	9,421,000	0.23	1,380,000	8,041,000	167,000	8,208,000	0.20
1900	8,960,000	0.22	1,428,000	7,532,000	173,000	7,705,000	0.19
1901	7,929,000	0.19	839,000	7,090,000	105,000	7,285,000	0.18
1902	8,680,000	0.21	1,103,000	7,577,000	221,000	7,798,000	0.19
1903	8,935,000	0.21	1,065,000	7,870,000	129,000	7,999,000	0.19
1904	8,563,000†	0.20	811,000	7,752,000†	124,000	7,876,000†	0.18

* Including a small quantity of pig-iron in the years prior to 1890.

† Provisional figures.

The Motor Exhibition which opens at Olympia on the 17th inst., gives every indication, as far as it is possible to form an opinion in advance, of being a great success. The list of exhibitors is an imposing one, and the importance of the exhibition is undoubtedly enhanced by holding it in November instead

of February, and thus anticipating the exhibition in Paris, where foreign firms have hitherto first exhibited their new models. It is now clear from the list of entries that foreign manufacturers intend to show their 1906 models at Olympia. Although this may not mean, that as one writer states it, "the centre of the motor industrial struggle has shifted from France to England," the fact is not without its bearing on the growing importance of the motor industry in this country. Comparing the exhibition to be opened on Friday next with its immediate predecessor, one thing that will strike visitors is the growth in the commercial vehicle class of exhibits. These are for the first time to be grouped together, and accorded space commensurate with the growing importance of this branch of the industry.

In his address to the Institution of Civil Engineers on Tuesday last, Sir Alexander Binnie made a new departure. Hitherto, it has been the custom for presidents to include in their presidential address some account of the particular department of civil engineering in which their own energies have been engaged. Sir Alexander Binnie's address was practically a survey of the history of civil engineering in this country, and it was listened to with keen interest. He drew attention to the surroundings under which the early engineers had to perform their work. His account of the work of Brindley, Smeaton, James Watt, John Rennie, and Thomas Telford, brought out vividly the difficulties and disadvantages with which these early engineers had to contend. Sir William Preece, in proposing a vote of thanks to the president for his address, pointed out that the president might perhaps have paid a little more attention to the connection between engineering and science in the early days of engineering. Sir Alexander Binnie claimed that he had, by inference, shown that the early engineers had to be their own scientists. Smeaton himself was a man of very high in-

tellect, and Watt was not only an engineer, but a natural philosopher. Science was deep in the debt of engineering for the work done by the pioneers of the profession, some of whose work executed under all the disabilities to which he had directed attention, might even challenge comparison with the civil engineering of the present day.

There will, no doubt, be a sharp division of opinion among business men as to the propriety of the step taken by the London County Council last Tuesday in regard to the Thames steamer service. As in the development of many new enterprises, the Council found themselves between Scylla and Charybdis. To continue the service means a loss, and to discontinue it also means a loss, but while the money in the first case is a fairly definite quantity the loss connected with disorganisation of staff and the effect of entire suspension can scarcely be gauged. The London County Council has been so freely criticised that we are apt sometimes to overlook the fact that the steamboat service was badly wanted, and that it is, moreover, a scheme of great potentialities. Few private firms, we imagine, would have expected to make a profit on the first year in such an undertaking. Mr. John Burns believes that the service should be treated as part of the tramway service, and that if this is done, in a few years it will pay. A step in this direction has already been made by the issue of combined boat and tram tickets. For the present it has been decided to carry on a reduced service, and a further report is to be brought up on the November returns. It is scarcely likely that these will be of a particularly encouraging nature unless something is done to make the steamers more comfortable for winter traffic. In the meantime, like other business organisations, the London County Council steamboat service will have to take the fat with the lean; nothing, as the member for Battersea points out, can be got by surrender to panic.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

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New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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MEETINGS, ETC., FOR THE ENSUING WEEK.

FRIDAY, NOV. 10.—Physical Society: Meeting at Royal College of Science, Exhibition Road, South Kensington: Papers, "The Question of Temperature and Efficiency of Thermal Radiation," Mr. James S. Vinburne; "Note on Constant-deviation Prisms," Mr. T. H. Blakeley.

SATURDAY, NOV. 11.—Manchester Association of Engineers: Paper "Jubilee of the Association," Mr. Thos. Ashbury.

MONDAY, NOV. 13.—Institution of Marine Engineers, Romford Road, Stratford, 8 p.m.

TUESDAY, NOV. 14.—Institution of Electrical Engineers (Glasgow Local Section).

WEDNESDAY, NOV. 15.—Liverpool Engineering Society, 8 p.m.: Paper "Processes for Rendering Iron and Steel Non-Corrosive."

THURSDAY, NOV. 16.—Institution of Mining and Metallurgy, Burlington House, Piccadilly, 8 p.m.; Chemical Society, 8.30 p.m.

FRIDAY, NOV. 17.—Institution of Mechanical Engineers, Storey's Gate, 8 p.m.: Paper, "Seventh Report to the Alloys Research Committee," 8 p.m.—Institution of Electrical Engineers, (Manchester Local Section). Motor exhibition opens at Olympia.

NEWS ITEMS.

Estimates have been prepared for proposed new railway from Blackpool to Southport, thence joining the Midland system at Wigan.

It is reported that the Government will introduce next session a Bill for the establishment of a Traffic Board for London upon the lines recommended by the Royal Commission.

The great scheme of dock and harbour development at Seaham Harbour, operations on which have been in progress for six years past, have now reached the stage of practical completion. The new dock is to be opened by Mr. Balfour to-morrow.

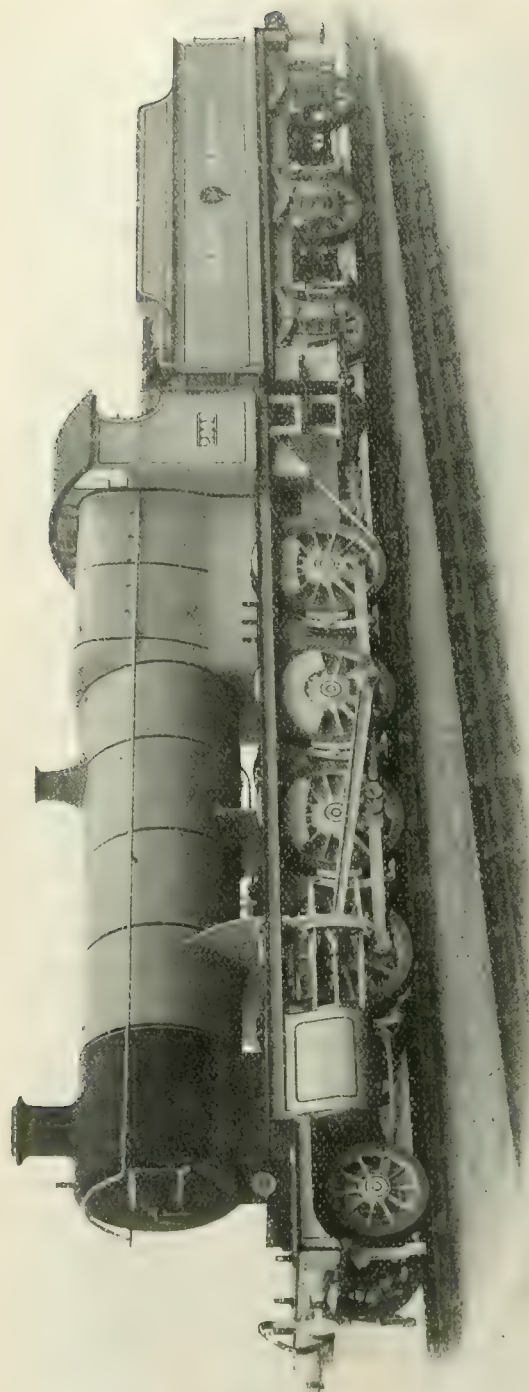
The Bath and West Society will visit Newport next year. Elaborate preparations are to be made at Derby to welcome the Royal Agricultural Society, and it is understood that the 1906 show has already been guaranteed against loss.

The meeting of the Institute of Mechanical Engineers on Friday next will be devoted to the reading and discussion of the seventh report to the Alloys Research Committee on the properties of a series of iron-nickel-manganese-carbon alloys, by Dr. H. C. H. Carpenter, Mr. R. A. Hadfield, and Mr. Percy Longmuir.

The European agents for the Toledo Machine and Tool Company, whose No. 93 geared power press was described in our last issue, are Messrs. Selig, Sonnenthal and Co., of 85, Queen Victoria Street, and Lambeth Hill. We are informed that a number of these large presses are in use at the works of the British Westinghouse Electric and Manufacturing Company, Ltd.

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From the Great Western Railway Magazine.

G.W.R. "CONSOLIDATION" TYPE ENGINE.

Leading pony truck and outside cylinders. Designed by Mr. G. J. Churchward, locomotive superintendent, and built at Swindon.

Cylinders, 18 in. diameter by 30-in. stroke; diameter of eight-coupled wheels, 4 ft. 7½ in.; heating surface, 2,143 sq. ft.; steam pressure 200 lbs. weight of engine only loaded, 68 tons, 6 cwt.

The Royal Society.

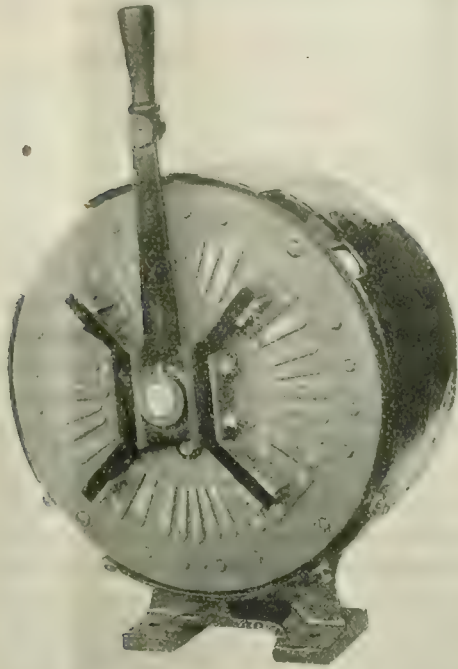
At the anniversary meeting of the Royal Society, at the end of the present month, the following officers and members of council will be proposed for election:— President, Lord Rayleigh, M.A., D.C.L., O.M.; treasurer, Mr. Alfred Bray Kempe, M.A.; secretaries, Professor Joseph Larmour, D.Sc., D.C.L., LL.D., and Sir Archibald Geikie, D.C.L., Sc.D., LL.D.; foreign secretary, Mr. Francis Darwin, M.A., M.B.; other members of the council, Dr. Shelford Bidwell, Sir T. Lauder Brunton, M.D., Professor J. Norman Collie, Ph.D., Professor Wyndham R. Dunstan, M.A., Professor John Bretland Farmer, M.A., Professor Francis Gotch, D.Sc., Dr. Sidney Frederic Harmer, Sir William Huggins, K.C.B., O.M., Professor Edwin Ray Lankester, M.A., Dr. John Edward Marr, Mr. George Ballard Matthews, M.A., Mr. Hugh Frank Newall, M.A., Sir William Davidson Niven, K.C.B., Professor John Perry, D.Sc., Professor Ernest Henry Starling, M.D., Professor William Augustus Tilden, D.Sc.

Steel Railway Wheels.

According to the Railway and Engineering Review of Chicago, the use of steel wheels on high-speed electric railways of America, is increasing daily and gives indication of soon becoming universal. The progress in this direction has been merely a repetition of steam railway experience. In each case the beginnings have been with light-weight cars, for which service the chilled cast iron wheel seemed adequate. Later, the speed increased, and with it the weight of the rolling stock. The result in electric service, as in steam, has been the failure of the cast iron wheels and the adoption of steel as an improvement. Authorities seem now to be united in saying that steel wheels and steel-tyred wheels, in any of the various forms, are a decided improvement over cast iron wheels. It seems to be only a question of time until they will be recognised as the only proper usage on heavy cars for electric service as they long have been for steam service.

Milan Exposition.

At the Milan Exposition, which will be held between May and November, next year, exhibits in the transportation section will show the historical development of the various methods of travel. The dominant feature will be motion. All products, as far as possible must be shown in connection with the processes, thus filling the halls with live exhibits. Arrangements will be made for field tests and competitive trials in all classes where it is expedient. An especial feature will be the automobile display, to which an entire pavilion will be devoted. This will terminate in mid-summer, so that machines exhibited may be sold for early delivery.



"C. AND H." RADIAL ARM REVERSIBLE CRANE CONTROLLER. TYPE A.

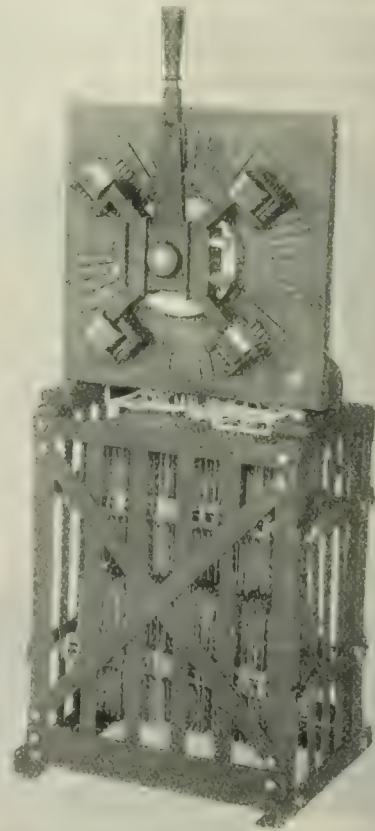
New Radial Arm Crane Controllers.

By courtesy of the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., we illustrate two of their new types of crane controllers. In designing these, an attempt has been made to overcome the difficulties met with in former types and to attain with the most simple construction possible, proper control with the minimum number of points at which arcing could occur as the controller deteriorated in service, and to make certain that when arcing did occur it would be under predetermined conditions, and with ample protection. In addition provision was made for ease of operation, adaptability to all conditions of service, ease of renewals and interchangeability of parts.

In type B these ends were achieved by mounting the front above the resistance, thus giving free accessibility to connections on the back of the slate. The front itself consists of four sets of segments, the connections of which are so arranged that no reversing sector is necessary. The resistance is also arranged in four sections, each connected to its respective set of segments, making the wiring simple, and eliminating crowding.

The lever is in three places, insulated from each other by large single pieces of insulating material which are sufficiently massive to withstand any mechanical strain to which they may be subjected in use. Before being separated this lever is cast in one piece, and all work on it is done with jigs, which insures positive interchangeability.

The blow-out consists of a coil surrounding and embracing the controller shaft on the front of the controller, and the iron of the framework is so disposed, as to complete the magnetic circuit, and give a powerful blow-out action at each of the four points at which the circuit is broken. The provisions of a multiple protected break for the circuit reduces destructive arcing to a minimum. A reliable centre-indicating device is provided at the "off" position, which enables the operator to feel the central or "off" position, but which will in no way prevent his reversing quickly.



RADIAL ARM REVERSIBLE CRANE CONTROLLER. TYPE B.

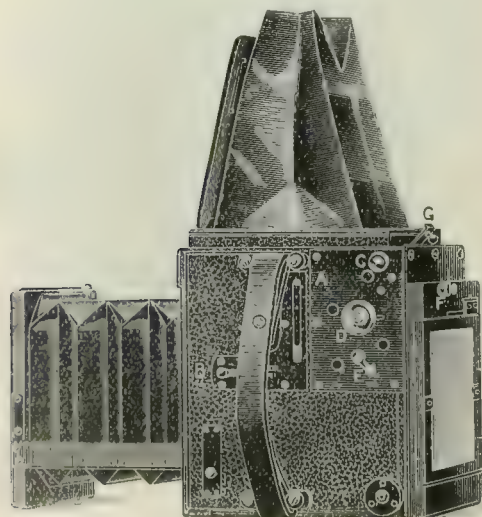
The type A controller differs from the above only in the mounting of the resistance, which is of iron enclosed tube porcelain-insulated construction, and is carried directly by the front. This controller and resistance may, therefore, be removed from the enclosing case and mounted directly in a recess provided, should this be desirable, as is frequently the case in applying it to a small trolley hoist work, etc., or it may be rotated within the case so as to permit it being placed in any desired position, as on the sides or top of crane cab. It may also be arranged for rope operation from the floor, in which case a centring spring is provided.

The resistance provided will give a speed reduction of 50 per cent. under the average load conditions on the crane.

A Camera Suitable for Engineering Photography.

The latest thing in cameras appears to be the "Soho" Focal Plane Reflex hand camera, which has just been brought out by Messrs. Marion and Co. We illustrate the instrument herewith because it would seem to be an ideal one for taking instantaneous views recording the progress of engineering works. One feature which renders it far in advance of the ordinary hand camera is that the pictures can be carefully focussed—an arrangement which will be appreciated by every amateur.

The camera, which is made in mahogany, covered with Morocco on the outside, measures, when closed, ($\frac{1}{4}$ -plate size) $6\frac{1}{2}$ in. by 7 in. by 6 in.; the bellows extension measures $10\frac{1}{2}$ in.



"SOHO" FOCAL PLANE REFLEX HAND CAMERA.

The front of camera has rising and falling movements. The back turns with a circular movement on pressing the catch marked F in illustration, to allow of horizontal or vertical pictures to be taken.

The focussing chamber rises into position on releasing the catch G. The reflecting mirror is brought into action by pressing downwards the point A until it catches at the bottom of slot. It is released by pressing towards the back of camera the release point B. This point B also acts as the release of shutter, but it is to be noted that mirror and shutter act independently. The focal plane shutter is a special feature of this camera, all adjustments being made from the outside without opening the camera in any way. Exposures can be regulated from $\frac{1}{16}$ th of a second to $\frac{1}{800}$ th, and time exposures of any duration can also be made.

The focal plane shutter has been improved and simplified by arranging that the alteration of the width of slit shall be recorded in the actual speeds given by each width, on the dial at left hand of camera. This obviates the necessity of any calculation. The usual tension spring has been abolished, experience having shown that the speed of a focal plane shutter depends on the width of the slit, while tension springs are necessarily liable to much variation of strength from various causes and thus introduce inaccuracies.

London Electric Power Schemes.

There is danger of chaos arising over the various schemes in course of inception. These now number five, and the following Bills are being prepared for next session. The London County Council Electricity Supply Bill, to enable the London County Council to supply energy in London and surrounding districts, and to enter into agreements with local authorities and others. Borough Councils Supply of Electricity Bill, giving power to the local authorities to link up their electric mains, and thus secure an interchangeable system. London Electric Lighting Companies' scheme, which it is understood will be embodied in a Bill for combining their forces, in order to generate electricity in bulk. The Railway Companies' scheme is also to form the subject of a Bill, under which certain Borough Councils have been promised a supply at $\frac{1}{2}$ d. a unit. The Administrative County of London and District Electricity Supply Bill is of course to be reintroduced.

The Dover Harbour Board on Friday confirmed the plans and agreements for the construction of the new water station, and the widening and the using of the extension of the Admiralty Pier at Dover. The work will cost about £350,000, and will be taken in hand as soon as Parliamentary powers have been obtained.

THE INSTITUTION OF CIVIL ENGINEERS.

THE opening meeting of the session was held in the hall of the Institution, Great George-street, Westminster, on Tuesday, when Sir Alexander R. Binnie, the new president, was installed in the chair.

Sir Guilford Molesworth, the retiring president, occupied the chair at the beginning of the proceedings, and among those present were Sir George B. Bruce, Sir Benjamin Baker, Lord Brassey, Sir William H. White, Sir William Preece, Sir Alexander A. B. Kennedy, Sir John I. Thornycroft, Mr. Charles Hawksley, Mr. R. A. Hadfield, Mr. Alex. Siemens, Professor W. C. Unwin, Mr. Robert Hammond, Dr. H. R. Mill, Dr. F. Elgar, Dr. S. F. Deacon, Mr. M. Fitzmaurice, and Mr. C. A. Brereton.

At the outset of the proceedings, in accordance with the usual custom, a tribute of respect was paid to those members of the Institution who had died during the recess.

Sir Guilford Molesworth said that the death roll had been more than ordinarily heavy, the deceased members including several distinguished men. They were the poorer by the deaths of Mr. James Mansergh, F.R.S., and Mr. George Robert Stephenson, past-presidents, and Sir William Shelford, member of Council.

Sir Guilford Molesworth then introduced his successor into the chair. He said that Sir Alexander Binnie's name was familiar to all those present from his association with large and important engineering works, and more particularly through the position he had occupied of chief engineer to the London County Council. Sir Alexander had been a member of the Institution for forty years.

Sir Alexander Binnie was then formally inducted into the chair, and it is interesting to note that the chair is the actual one used by Thomas Telford, so intimately associated with the foundation of the Institution in 1828.

Sir George Bruce, as senior past president, proposed a vote of thanks to the retiring president. He said he had the privilege of belonging to the Institution for a period of fifty-five years. If he might define civil engineering, he would say that the profession had for its aim the lessening of human toil, the increase of human comfort, and the advantage of the world all the world over.

Looking back over this long period he recalled many eminent men who had occupied the president's chair. The aim of all succeeding presidents had been, he was sure, to maintain the Institution in the high position it was left by those famous men who had gone before. Sir Benjamin Baker seconded the resolution which was carried with acclamation.

Sir Guilford Molesworth briefly acknowledged the vote.

Sir Alexander Binnie then delivered his presidential address, an abstract of which follows :—

PRESIDENTIAL ADDRESS.

Sir Alexander Binnie said he proposed to trace out some of the circumstances which surrounded the lives of our predecessors. In looking at the past we had to take into account not only the social, scientific, and philosophical advancement of the time in which our predecessors lived, but also the public welfare and the public wealth, out of which latter alone could great works be carried on. It was not until the eighteenth century that we could say that the profession of civil



Photo, Elliott and Fry.

SIR ALEXANDER R. BINNIE, F.G.S., M.I.MECH.E.,
President, Institution of Civil Engineers.

engineering arose in this country. Yet, during the seventeenth century and its predecessors there were engineers whose names had come down to us with veneration. Among these he might mention Sir Hugh Myddelton, in the time of Elizabeth and James I., Cornelius Vermuyden, the Dutch engineer, who did so much for the reclamation of our fens, and Dudley, who commenced to manufacture iron by puddling. Yet, looking back to those earlier times, one must be impressed with the fact that we were deeply indebted to foreigners for almost all the arts of life. Silk-weaving, pottery, and a host of others came to us from the Continent, and even when it was necessary to build old Westminster Bridge a Swiss had to be introduced in the person of Lebelye, in the earlier part of the eighteenth century. It was about this period that the Newcomen steam engine was introduced, and Abraham Darby worked.

THE PIONEERS OF CIVIL ENGINEERING.

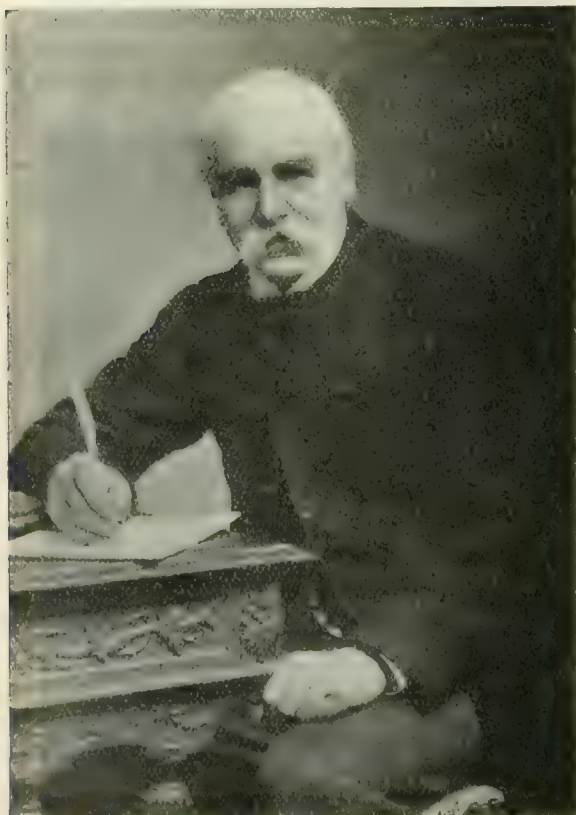
A noteworthy figure of the early part of the eighteenth century was James Brindley, the son of a small farmer,

who was destined, owing to the caprice of a young lady of fashion, Elizabeth Gunning, Duchess of Hamilton, to become one of the first of our canal engineers. Owing to the disagreement between this lady and the Duke of Bridgewater, the latter retired to his seat at Worsley, calling Brindley to his aid, and devoted the remainder of his life to the construction of those wonderful canals which laid the foundation of our inland navigation. To trace the life of Brindley was somewhat difficult. He was illiterate, could hardly write; and yet, with wonderful intuition, he was able to calculate and to estimate in a manner which soon brought him into prominence as one of the engineers of his time.

A very different type of man was John Smeaton, the father of the civil engineering profession, who was born in 1724. Smeaton was a man of very high intellect. If anyone wished to admire his scientific reasoning they could not do better than refer to the papers which he presented to the Royal Society. He would instance his paper on the "Power of Wind and Water to drive Mills." It was, and always must remain, a classic among engineers of how to combine the mechanical art with reasoning faculty of the simplest and clearest nature. Smeaton's reports when carefully read, were the epitome of the knowledge of the time. In his long life of sixty-eight years, extending from 1724 to 1792, Smeaton was engaged on almost every kind of engineering work.

MECHANICAL SCIENCE IN ENGLAND.

He came next to James Watt. Watt from the very first was not only a skilled handicraftsman, but a mechanical genius of the highest order. Being called upon to repair a model of a Newcomen engine, he was led to study the whole question, and arrived at the conclusion that it was an exceedingly wasteful machine. He soon detected that this was due to the cooling of the cylinder by the injection of the condensing water, and inaugurated a new era and a new power in the development of manufactures by the introduction of a separate condenser. It would be tedious to narrate all the improvements which from time to time he applied to the steam engine. At an early period he was brought into communication with Wedgwood and Erasmus Darwin, and through them made the acquaintance of Dr. Boulton, of Birmingham. Priestley also was one of those with whom he was acquainted. Out of this grew the partnership between Boulton and Watt, the establishment of the works at Soho, and the development of the steam engine in the state in which, practically, it had come down to the present day. One could hardly appreciate what this



Photo, Elliott and Fry

SIR GUILFORD L. MOLESWORTH, K.C.I.E.,
Immediate Past-President, Institution of Civil Engineers.

meant to the development of the manufacturing industries of the country, whether considered from the mining or the manufacturing standpoint. It enabled power to be economically applied wherever coal was available, and the canals which were then growing up supplied the fuel necessary for the purpose.

As an instance of the backward state of mechanical science in those times, it is related that when Watt laid before Boulton and Smeaton his proposals for the construction of the steam engine at Soho, Smeaton expressed his doubt as to whether the mechanical skill of the country was able to perform with the necessary accuracy the work required.

Referring to the fact that in the past Great Britain had been indebted to foreigners, it was interesting to note that until Cort's puddling invention was brought into use, in the latter end of the eighteenth century, the British navy was restricted to the use of iron imported from Russia.

Watt's life was one that could be studied with profit by every engineer, and the lessons which it taught of patient industry and a determination to study not only the actual details of the work, but also all the allied natural forces, which (some of them) appear at first sight hardly to be cognate to the profession of an engineer.

THE FIRST INSTITUTION.

About the year 1760 it was conceived that it would be an advantage if engineers, during their visits to the metropolis, could meet, make each other's acquaintance, and discuss professional matters. This led to the establishment of a small society, the members of which were known as the Society of Civil Engineers, and which still existed under the name of the Smeatonian Society of Civil Engineers.

Intimately connected with the society was John Rennie. He was brought into connection with Watt in the construction of the Albion Mills in Southwark, and gradually developed, with Watt's assistance, into one of the engineers of his day. Road-making was improving, and he began to practise as a road-constructor and builder of bridges, and after the retirement of Smeaton in 1791, Rennie was consulted respecting numerous projects of canal undertakings. The Kennet and Avon Canal, with its aqueducts over the river Avon, still bears testimony to his designs. The Rochdale Canal, the Aire and Calder Canal, and many others, were carried out under his superintendence. He also was largely engaged in the drainage and reclamation of the fens in Lincolnshire, Cambridge-shire and South Yorkshire. He was one of the great bridge-builders of his time—Waterloo Bridge and the

cast-iron bridge over the Thames at Southwark, one of the finest monuments of metallic bridge construction that has ever been erected, were examples of his work. He was also engaged in the construction of the London Docks, for although the Thames was the great highway of commerce, the first docks constructed were those which we know as the West India Docks, constructed by Mr. William Jessop, in 1802. Rennie constructed the London Docks, the East India Docks, was consulted about the improvement of the Clyde, Holyhead Harbour, the Hull Docks, Greenock, Leith, and Southampton, and was also consulted about the Bell Rock lighthouse, but his great work in this direction was the construction of the Plymouth breakwater. Towards the end of his life he was concerned in preparing the designs of London Bridge, which unfortunately he did not live to complete, that work being accomplished by his son, Sir John Rennie, a past-president of the institution.

THE TELFORD ERA.

One who was associated with the foundation of the Institution of Civil Engineers, was Thomas Telford, who was born in Eskdale in the year 1757. Telford became, of course, the great bridge-builder of his era, and constructed bridges almost in every part of the country. Harbours also engaged his attention, and he was the engineer of the Caledonian Canal and the Birmingham and Liverpool Canal. He also distinguished himself as the great road-maker of his time.

Nothing, perhaps, showed so clearly the advance of the profession since the time of Telford as a comparison of his notebook, which would be found in his biography, with the pocket-book of his immediate predecessor in the chair (Sir Guilford Molesworth).

THE GROWTH OF CIVIL ENGINEERING.

As the period before 1832 was the period of road-making, canal-engineering, and the commencement of docks and harbours, so the period which had since elapsed has since been essentially the railway age. The railway period arose out of the necessity and the growing demand for means of communication, and under the able hands of George and Robert Stephenson, Joseph Locke and the younger Brunel, the whole country was gradually covered with railways. Coincident with the advance of railways had been the growth of an entirely new, and by our ancestors unthought of, engineering work. He alluded to the progress made during the last fifty years in electrical science.

That period was also signalled by the development of sanitary engineering, both in relation to drainage and water supply; and the discovery of that wonderful world of microbe life, on which the national health and cleanliness depend. Marine engineering had been developed, and had knit together all parts of the globe.

It might, therefore, be claimed that by railway, ocean navigation, and sanitary engineering, civilisation had been advanced more rapidly than in any previous age.

THE INFLUENCE OF PEACE ON PUBLIC WORKS.

He had already noticed, in speaking of the lives of the earlier engineers, the great advance in material prosperity in this country, which occurred during the reigns of George I., George II., and the early years of George III. Again, between the years 1832 and our own time there had been a wonderful manifestation of wealth and prosperity, as compared with the earlier years of which he had been speaking. This was largely due to the long peace which elapsed between 1815 and 1854, aided by the widening effect of legislation, in removing restrictions on trade, and widening out in all directions the avenues of possible advancement of the people. Consequently, engineers were largely indebted to the blessings and the benefits of peace. Whenever war occurred, it meant a retraction of the spending power of the nation. There were limitations even in the most opulent nation of the spending power of the body politic.

He had reviewed what had taken place in the past. The earlier masters worked under great disadvantages. Science to them was a thing almost unknown in our acceptance of the term, yet they all of them endeavoured to make themselves perfect masters of what knowledge it was possible to possess, and to apply it with an energy displayed by few at the present day. Chemistry was in its infancy.

FUTURE OF THE PROFESSION.

Electrical science during the period that he had reviewed was gradually brought within the laws of Nature by the work of those great masters he had mentioned, and in more modern times there was the work of Faraday, bringing the magnetic and electrical fields into common union.

Due to the work of James Watt, Count Rumford, Joule and Tyndall, the relation between heat and work had been traced out, and the recent investigations of Dewar and others were opening out new conceptions of the behaviour of materials at low temperatures.

The investigations of recent years into the laws which governed the constitution of matter, both on

the chemical and physical sides, were gradually forming new conceptions as to the structure of all inorganic bodies.

The question was often asked: "What about the future of the profession; were the coming years to be as fruitful as the past?" Seeing how much was done by the limited knowledge of the beginning of either the eighteenth or the nineteenth centuries, and seeing how much more intimately, acquainted we now were with all the laws of Nature, he thought we might look to a development as much unknown to ourselves as our modern works were to our predecessors of the eighteenth century.

ROYAL SOCIETY MEDALS.

The list of medals recently awarded by the Royal Society includes the following:—The Copley medal to Professor Dmitri Ivanovitch Mendeléef, of St. Petersburg, for his contributions to chemical and physical science; a Royal medal to Professor John Henry Poynting, F.R.S., for his researches in physical science, especially in connection with the constant of gravitation and the theories of electrodynamics and radiation; the Davy medal to Professor Albert Ladenburg, of Breslau, for his researches in organic chemistry, especially in connection with the synthesis of natural alkaloids; the Hughes medal to Professor Augusto Righi, of Bologna, for his experimental researches in electrical science.

The Junior Institution of Engineers.

The recent annual general meeting of the Junior Institution of Engineers was also the first general meeting of the Society after its constitution as an incorporated body. The annual report of the Council showed increase in membership to 888. The scrutineers reported that the election had resulted as follows:—Chairman, Mr. Adam Hunter, Assoc.M.Inst.C.E.; vice-chairman, Messrs. Lewis H. Rugg, Assoc.M.Inst.C.E., and F. S. Pilling, M.I.Mech.E.; hon librarian, Mr. E. Eade; hon. auditors, Messrs. P. L. Young and W. H. de Ritter, M.I.Mech.E.; members of Council, Messrs. G. T. Bullock, F. R. Durham, Assoc. M.Inst.C.E., G. H. Hughes, M.I.Mech.E., and A. G. Young; provincial members of Council—North of England, A. E. Rasey, A.M.I.Mech.E.; Midlands, E. King, A.M.I.Mech.E.; Eastern Counties, J. Julian; Southern Counties, F. S. Miller; West of England, E. W. Porter, Assoc.M.Inst.C.E.; Scottish district, G. E. Jackson; Irish, W. E. Lally, M.I.Mech.E.; Welsh, H. F. Hunt, B.Sc.

THE CRYSTALLINE STRUCTURE OF ELECTRO-DEPOSITED COPPER.

BY PROFESSOR A. K. HUNTINGTON.

THE lines of crystallisation of an electro-deposited metal are the same as in a casting made on surfaces having the same inclination, i.e., the crystals form at right angles to the surface on which the deposit or the casting is made. It follows that when the crystals which form on surfaces more or less at an angle to one another meet, there will be want of continuity in the two sets of crystals, and a line of more or less weakness will have been developed.

To make this clear I have had a piece of copper deposit for making wire, polished* and etched with nitric acid in alcohol (fig. 1). Readers will see at once the effect the groove on the mandril has on the direction of the crystals of the deposit. There is, in fact,

* In order to polish the strip without rounding the edges, I had white metal cast round it.

a complete break in the continuity of the metal. To compare with this I have had photographed a casting composed of 50 copper + 50 zinc (fig. 2). It will be observed that crystals from the opposite long sides, which must be approximately parallel, do not even then merge one into the other, but show a break. These examples amongst other things point to the importance of avoiding sharp angles in castings and deposits when strength and not rupture is aimed at.

It will be interesting to study photo-micrographs of a cathode plate which has been deposited on a thin strip of electro-deposited copper (figs. 3 and 4). The crystals of the original strip have been continued in some cases in the cathode plate. This was the side of the strip which had not been in contact with the surface on which the strip was deposited and

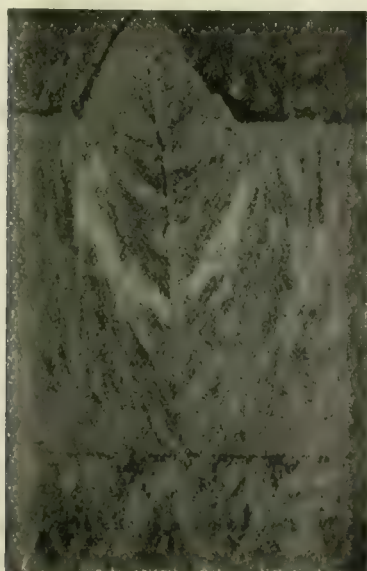


FIG. 1. COPPER DEPOSIT ETCHED WITH NITRIC ACID IN ALCOHOL.



FIG. 3. CATHODE PLATE, DEPOSITED ON THIN STRIP OF ELECTRO-DEPOSITED COPPER.

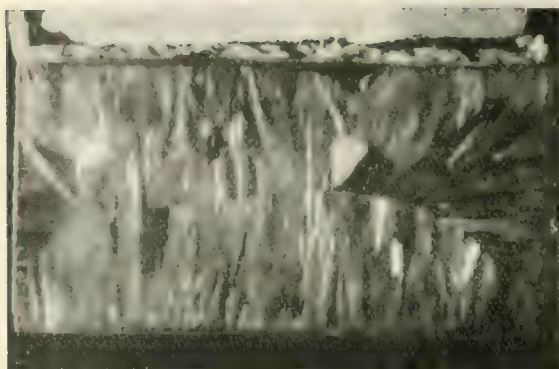


FIG. 2. CASTING COMPOSED OF 50 COPPER + 50 ZINC.



FIG. 4. CATHODE PLATE—SHOWING HOW CRYSTALS FOLLOW CURVATURE OF STRIP.

so had a clean crystalline face. The way the crystals follow the curvature of the strip is very apparent.

Another photo-micrograph (fig. 5) illustrates what happens when the electro-deposited copper is annealed. The long crystals of the deposit are completely broken up and become largely twinned. To compare with that, I show a photo-micrograph of a rolled copper rod which has been annealed (fig. 6). We may learn from these that brittleness due to the direction in which crystals form in castings and electro-deposits may be modified and probably completely removed by suitable annealing. This,

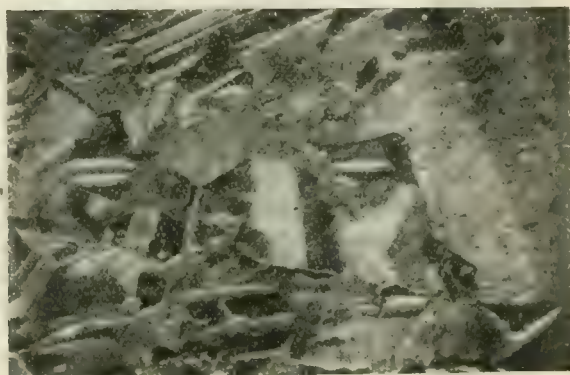


FIG. 5. ILLUSTRATING ELECTRO-DEPOSITED COPPER ANNEALED.

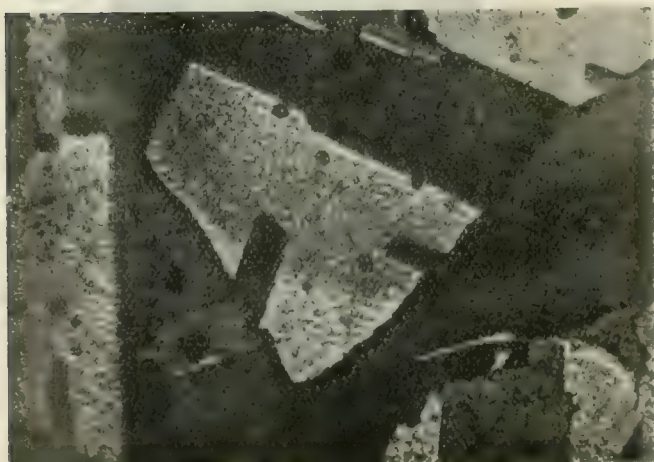


FIG. 6. ROLLED COPPER ROD AFTER ANNEALING.

however, would be the case only when there was a line of weakness and the continuity was not entirely broken, otherwise the unequal expansion caused by the heat would make matters worse rather than better.

I may be wrong, but I am under the impression that these are the first photo-micrographs of electro-deposited copper, at any rate good ones, which have been published, which somewhat astonished me when my attention was called to the fact by my assistant, Mr. Desch, who has been very successful in bringing out the points referred to.

Abstract of communication to the Faraday Society.

SMALL ELECTRIC FURNACES.

BY J. H. STANSBIE, B.Sc., F.I.C.

The main object of this paper is to describe some simple forms of electric furnaces which can be readily fitted up for experimental purposes.

A small resistance furnace for demonstrating the melting of metals is readily made by chipping the large face of a firebrick so as to form the cavity, and the two semi-circular channels running from it to the ends of the brick. A second brick with a shallower cavity and similar channels serves for the top. The cavity forms the hearth of the furnace, and the channels allow of the introduction of two carbon rods which are fixed with their ends just projecting into the

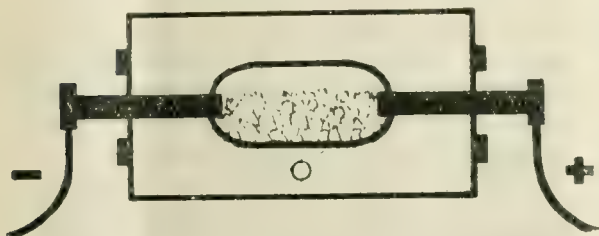


FIG. 1. SHOWING VERTICAL SECTION OF RESISTANCE FURNACE.

cavity. The metal is placed in the cavity, and covered with a layer of small pieces of carbon so arranged as to fill up the space between the carbon rods. Arc carbons broken up serve the purpose very well. The top is placed in position, and the current switched on. The temperature rises rapidly, and a charge of cast-iron is soon melted. This can be run from an inclined tap-hole passing through the bottom of the cavity, by plugging the upper end with a piece of the metal before charging. The metal plug melts last, and the whole charge runs from the furnace in a continuous stream. A vertical section of the furnace is shown in fig. 1. A slight modification of this furnace enables it to be used with a carbon tube. For this purpose an inclined channel is made in the walls of the hearth, at right angles to the length of the bricks, to hold the tube, the ends of which project from the sides of the furnace. The cavity is filled with carbon fragments to surround the tube and connect the rods. On passing the current into furnace, a rapid increase in temperature takes place, and substances to be experimented with can be readily introduced into the tube. Reductions

and fusions are rapidly effected. The tubes are readily made by drilling pieces of arc carbon of requisite length. Fig. 2. shows this particular type of furnace in vertical transverse section.

ARC FURNACE OF SIEMENS TYPE.

A small arc furnace of the Siemens type is easily fitted up. A hole is drilled in the side of a carbon crucible and a carbon rod fitted tightly into it. The crucible is placed in a cavity in a fireclay block, which also supports the carbon rod along part of its length. The block is placed on a small iron table having a vertical rack motion, and a carbon rod to act as the positive electrode is fixed vertically over the crucible. When the charge has been introduced and the current switched on, the arc is readily struck by raising and lowering the table. The operation can be regulated by the same means. Fig. 3 shows the furnace in vertical section.

MOISSAN LIME FURNACE.

A more durable form of the Moissan lime furnace can be made with strongly compressed magnesite bricks. Two of the bricks are chipped out on corresponding faces, so as to form the crucible cavity and the channels for the carbon rods. They are then braced firmly together, and the top formed by a third brick hollowed out a little to correspond to the cavity

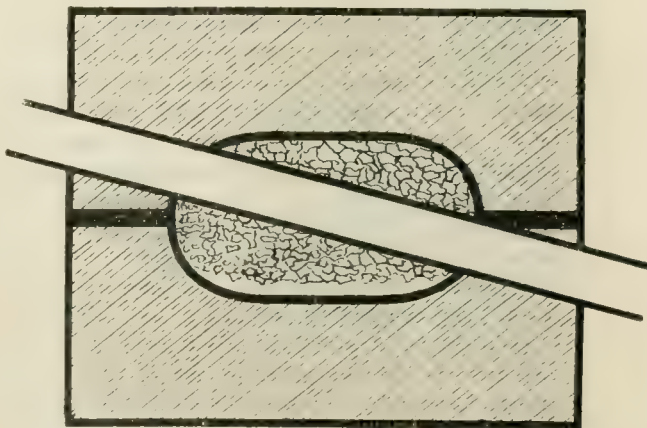


FIG. 2. SHOWING VERTICAL TRANSVERSE SECTION OF MODIFIED FORM OF FURNACE.

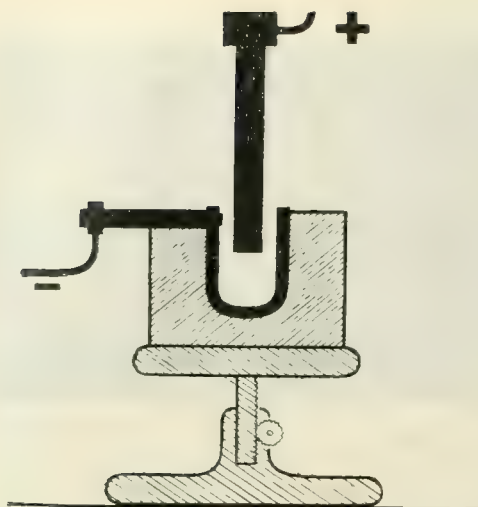


FIG. 3. VERTICAL SECTION OF SIEMENS' TYPE ARC FURNACE.

below. The electrodes are carbon rods, 1 in. in diameter, and 15 in. long, having copper electrode deposited on part of their length to insure good contact. The reactions are carried out in a shallow carbon crucible, and the majority of the fusion and reduction experiments requiring very high temperatures can be made in it. Chromium and molybdenum are readily reduced from their oxides.

The current used in these furnaces varies from 100 to 200 amperes, at a pressure of 110 volts in the mains.

Abstract of paper read before Birmingham Electric Club.

San Francisco Piers.

The two piers that are now being constructed at San Francisco, California, are stated by the Marine Review to be among the largest ever built on the Pacific coast. These piers are being built by the state of California, and are for the use of the Pacific Mail Steamship Company. Each of these piers is 840 ft. long and 132 ft. wide. They are separated by a slip 840 ft. long and 200 ft. wide. This slip is long and wide enough to admit two of the largest vessels in the world to lie side by side along each pier and receive or discharge cargo at the same time. The piers are supported by cylinders composed of concrete. Under each pier are 576 of these pillars—or 1,152 supports in all. The cylinders are arranged in rows or bents, extending across the narrow way of each pier. In each row are thirteen cylinders—five of which are 5 ft. in diameter and eight 4 ft. in diameter. These pillars vary in length from 24 ft. to 60 ft.—the shorter ones being near the shore and lengthening as the pier extends outwards.

THE PRESERVATION OF IRON AND STEEL SURFACES.

BY SHERARD COWPER-COLES.

THE protection of iron and steel from corrosion is a difficulty all engineers have to contend with; the subject is an important one, and has not received the attention it deserves. At the present time there are three methods in vogue for applying zinc to iron and steel surfaces: (a) hot or molten galvanising; (b) electric or cold galvanising; (c) dry galvanising, or "Sherardising." The galvanising of iron is so important a process that one-half of the total zinc production of the United States is used for the purpose. As a metallic protective coating for iron, zinc is still considered by engineers to be the most economical and durable of all methods for preventing corrosion. Zinc is electro-positive to iron, and in the presence of moisture forms a galvanic couple, the zinc dissolving and the iron remaining intact. The new process, called dry galvanising, or "Sherardising," is distinctive from hot and electro-galvanising. The process was discovered by the writer when making some experiments on the annealing of cast-iron.

The first step in the dry process is to free the iron from scale and oxide. The articles to be rendered rustless are then placed in a closed iron receptacle, or drum, charged with zinc dust and heated to a temperature of from 500 deg. to 600 deg. F. for a few hours, and allowed to cool. The drum is then opened and the iron articles removed, when they are found to be coated with a fine homogeneous covering of zinc, the thickness depending on time and temperature. It will be observed that the temperature employed to bring about this result is about 200 deg. F. below the melting point of zinc. The low temperature required and the economy effected in the amount of zinc consumed makes the process cheap as compared to the process of dipping in molten zinc. The whole of the zinc is utilised; there is no waste as in the hot galvanising process. This new process of dry galvanising is not limited to the coating of iron with zinc, it has been successfully applied to coating iron with aluminium, copper, and antimony. It has also been applied to coating various other metals, for instance, coating aluminium and copper with zinc. Copper and its alloys, subjected to this process, are case-hardened on the surface, and the latter can be rendered so hard that it is scratched with difficulty.

Abstract of paper read before the Society of Engineers.

THE PROBLEM OF THE GAS TURBINE.

BY DUGALD CLERK, M.INST.C.E.

THE success obtained by the Hon. C. A. Parsons, and his many able followers, with the steam turbine in its various forms, has naturally attracted the attention of engineers to the apparently analogous problem of the internal combustion turbine. Accordingly, much mathematical and engineering ability has been recently devoted to the subject—so far, I am sorry to say, without concrete result. In this subject, as yet, the dreams of the theorist obstinately decline to realise themselves in tangible iron and steel.

As long since as 1884 Mr. Parsons outlined the fundamental idea of nearly all subsequent proposals for gas turbines.

THE TEMPERATURE PROBLEM.

In most of the recent discussions upon gas-turbine problems, it has been recognised that the temperatures possible in the cylinder gas engine are impossible for the gas turbine. It has been fully proved by many investigators, including myself, that the temperatures quite common in ordinary gas-engine practice range as high as 2,000 deg., although in the best practice for most economical results 1,500 deg. C. or 1,600 deg. C. appears to be an upper limit. With the temperatures of 1,500 deg. C. or 1,600 deg. C. a first-class modern gas engine of about 50 h.p. will give an indicated efficiency of 35 per cent. At the same time the negative work of the cycle is so low that the mechanical efficiency of the engine may be as high as 86 per cent., or even over. If one realises what the temperature 2,000 deg. C. means, it becomes very evident that no turbine constructed either on the lines of Parsons or Laval could possibly be made to work with continuous supply of such gases; 2,000 deg. C. is considerably over the melting point of platinum. It is much higher than the temperature at which cast-iron flows from the crucible, or, indeed, the temperature of the interior of the blast furnace itself. Any blades of iron, steel, or, in fact, of any other material, even brick-fire itself, becomes fluid or semi-fluid at this temperature. It is obviously hopeless, therefore, to attempt, in the gas turbine, temperatures which are quite feasible in the cylinder engine. This fact, as I have said, is generally recognised. It is accordingly said, by those who take a favourable view of the gas turbine, that it is necessary to supply the turbine with gases at a much lower

temperature. Mr. Neilson fixes the temperature of 700 deg. C. as one which steel turbine blades would probably stand, without too rapid deterioration. I fear that on this point I must differ from him, because, in my experience, oxidation of steel, and even iron, is a fairly rapid process at this temperature. Nothing new has been proposed as to the thermodynamic cycle of the gas turbine, so that all reasoning upon efficiencies depends upon the deductions already made from internal combustion engine practice.

PROPOSED CONVERSION INTO KINETIC ENERGY

Seeing the impossibility of constructing a turbine with materials to stand a high temperature, many have proposed to convert high temperature into kinetic energy, so that instead of having work stored up in the gas in the form of heat, the heat shall disappear, and the energy of the heat be transformed into motion of the gaseous particles at a high velocity. Such proposals, then, include the compressing of a gaseous mixture to, say 50 lb. or 60 lb. above atmosphere, the igniting of that mixture within a combustion chamber at constant pressure, and the expansion of the mixture through an expanding jet of the Laval type, so as to drop the temperature and obtain its equivalent in kinetic energy or velocity of the gaseous particles. The rapidly moving particles at the relatively low pressure and temperature are then allowed to impinge upon rapidly rotating blades of sickle configuration, and they are supposed to give up their energy of motion to those blades, and so expend work upon the turbine. This appears to be the most feasible of all the gas-turbine proposals, so I will proceed to examine it a little more minutely.

Success by this cycle of operations requires—

1. A rotary or turbine compressor of high relative efficiency.
2. An expanding nozzle which shall ensure that free expansion is quantitatively equivalent to adiabatic expansion behind a piston.
3. A rotating turbine of such construction as to secure very high efficiency of transformation of kinetic energy of the moving gas into effective work available at the turbine shaft.

THEORETICAL AND PRACTICAL DIFFICULTIES.

Assuming air to be the working fluid, and specific heat to be constant through the temperature range it is easy to calculate the efficiency of the Joule or

Brayton cycle, which these operations in effect represent. It would be useless to attempt to work a turbine at a pressure so low as to be relatively inefficient compared with the gas engine, so I have chosen a Joule cycle of, say, 48 per cent. ideal efficiency, which in a cylinder gas engine would probably give in practice about 30 per cent. indicated efficiency. For this ideal efficiency the pressure of compression would require to be 141 lb. per square inch absolute. To give power with a reasonably small pump, I shall assume a maximum temperature of 1,700 deg. C. That is, assuming a perfect compressor and a perfect nozzle expander, the temperature would only fall from 1,700 deg. C. to 750 deg. C. Plainly this temperature would be too high for a Laval disc with blades. In order to get a reasonable temperature on expansion, it would be necessary to assume a maximum temperature in the combustion chamber no higher than 1,000 deg., and this would bring down the temperature after complete expansion to about 500 deg., which, no doubt, steel turbine blades can be expected to stand for some considerable time.

With these assumptions, however, the gas turbine would not be very economical, as compared with cylinder engines, even assuming all difficulties overcome. The theoretical and practical difficulties, however, are very serious indeed.

To begin with, the question of an efficient air compressor. I am not aware of any turbine compressor capable of compressing up to 140 lb. absolute from atmosphere with anything like 60 per cent. efficiency. Before success could be attained, this efficiency of compression, so far as diagram is concerned, should be at least 90 per cent., in order to allow for unavoidable mechanical and other losses in the subsequent processes. It has, it is true, been proposed to substitute cylinder compressors operated from the turbine, instead of turbine compressors, but no gas turbine with cylinder compressors could, in my view, succeed.

Assuming, however, even 90 per cent. efficiency from a turbine compressor, and assuming that we have a compressed gaseous mixture burning freely in the combustion chamber at the desired pressure and temperature, we have yet to face the problem of the expanding nozzle.

THE EXPANDING NOZZLE PROBLEM.

It will be easily recognised that to obtain a sufficient temperature drop in an expanding nozzle necessitates the practical absence of turbulent motion of every kind; that is, to expand adiabatically the jet must be so constructed that there is an absolutely smooth flow from high pressure to low, and no impact or

loss of velocity from any cause whatever. So far as I understand expanding jets, no adiabatic expansion so perfect as this has ever been obtained.

Assume, however, that the efficiency of expansion in such a jet is, say, 90 per cent. We now come to the question of the efficiency of conversion by the turbine blades. We shall find that the efficiency of conversion of the turbine, once high velocity is attained, does not exceed 80 per cent. In this respect the efficiency of conversion of rotating turbine blades is inferior to that of a moving piston in a cylinder. The reason of this is obvious. It is impossible to so arrange the impact of a rapidly moving gas with a turbine blade or blades in such manner as to entirely avoid turbulent motion. The impact, for example, of swiftly moving gases on a fixed surface results ultimately entirely in turbulent motion, which restores to the gas or to the blade struck all the heat which has disappeared in temperature fall due to adiabatic expansion. What is true of a fixed blade is to some extent also true of the moving turbine blades. A certain proportion of the energy existing in the gas in the form of motion is inevitably lost whenever this gas comes into contact with any solid surfaces. So much is this the fact that in designing steam-turbine blades for any type of turbine, the shape of the blades, the shape of the space between the blades, both moving and fixed blades, or fixed jet and moving blades, is of the first importance, and it has only been found by experiment that certain shapes of blades and passages have a much higher efficiency of conversion than other shapes. In this respect, too, the turbine principle is inferior to the cylinder and piston.

EFFICIENCY OF CONVERSION.

Compared with cylinder expansion, I cannot see how it is possible with present knowledge to obtain an efficiency of conversion in a gas turbine greater than 80 per cent. This, of course, is partly due to the high velocity of the issuing hot gases. To produce an efficient gas turbine, therefore, on the favourite cycle so much discussed recently, it is necessary first to have, as I have said, a very efficient compressor, a very efficient expanding nozzle, and a very efficient conversion when the moving gases strike the turbine blades. Using the numbers I have suggested, of 90 per cent. efficiency of compression, 90 per cent. efficiency of nozzle expansion, and 80 per cent. efficiency of conversion in turbine, we have, with a cycle having negative work equal to 0.4, the following efficiencies: To get 0.4 of work in compression, we shall require 0.445 of work put into the compression. On expanding in the nozzle we shall obtain 0.9 only of the total energy of the flame gases in the shape of kinetic energy,

and of that too, we shall only get 0.8 returned in the shape of available work by the turbine part. That is, we shall get a total work from the turbine of 0.72, and deducting the negative work $0.72 - 0.445 = 0.275$, that is, from a cycle which should give us 0.6 in work, we shall only get 0.275, or about 22 per cent. The practical efficiency of an engine of this kind will only be 22 per cent., even assuming the high efficiencies of compression and jet expansion which I have mentioned. In my view, no such efficiencies of compression or jet expansion are at present known, and accordingly there appears no likelihood of the production of any gas turbine which can rival the reciprocating gas engine in efficiency and in economy. To produce such a turbine requires the solution of three problems:—

1. An efficient turbine compressor, comparable in efficiency with cylinder compression.
2. An efficient nozzle expander with a higher efficiency than 90 per cent.
3. An efficiency of conversion of kinetic energy of the moving gases into work delivered at the turbine spindle, of greater than 80 per cent.

Either of these problems must be satisfactorily solved or else new materials discovered which will stand temperatures which at present melt firebrick. The outlook, I fear, is not hopeful.

MOST HOPEFUL LINE OF RESEARCH.

I quite agree with Professor Reeve, however, that the more hopeful line for the gas turbine lies in the use of steam to provide the working fluid under compression without a compressor, and in the heating of this steam when produced by a very small quantity of combustible mixture of gas and air under pressure. Such a turbine would be a compromise between what I may call the flame turbine and the steam turbine, and it presents more possibilities; but its efficiency would not be high, although no doubt such a machine could be got to operate mechanically with fair success.

This line of work depends upon the fact that negative work may be greatly reduced by using steam as working fluid, when steam is heated highly by internal combustion of a relatively small amount of inflammable gas and air. This proposal is more hopeful, but for success, even, it requires temperatures, in my view, too great for existing turbines to stand with economy. This proposal may be considered to be analogous to that of an excessive superheat, as used in an existing steam turbine.

From what I have said, you will see that my view of the future of the gas turbine is not favourable; but, notwithstanding, the subject is so fascinating

that many inventors and scientific men will doubtless continue to investigate the problem, and possibly new solutions may be discovered which are not dreamt of to-day.

Abstract of presidential address to the Junior Institution of Engineers.

NEWS ITEMS.

Up-to-Date Business Methods.

Messrs. W. F. Mason, Ltd., Manchester, have just inaugurated a very useful course of lectures for the benefit of their staff. The opening lecture was given in the drawing office of the Alma Works by their works manager, Mr. Thos. Wright, A.M.Inst.C.E., M.I.Mech.E., on the subject of "The Slide Rule, with Notes on the Value of the Answers." The lecture was illustrated by diagrams and a model slide rule, and an outline of the lecturer's notes was given to each person present.

The effort, we are glad to hear, was much appreciated by the staff, quite a number of whom have obtained rules for their own use. Encouraged by this result, a notice was issued intimating that further lectures would be arranged for if desired, and the written response has been so unanimous that other lectures are now promised, the subjects including: "Types of Gas Fired Furnaces"; "Rates of Combustion," and "Mathematics for Engineers." The firm are offering a small prize for proficiency in the use of the slide rule for ordinary engineering calculations and hope to further extend this idea in the future.

The Postmaster-General announces the early issue of a revised pattern of postal order, which has been devised with a view to greater convenience and with the object of affording increased security against fraud. The new orders will be for every 6d. from 6d. to 20s., and also for 21s. Spaces will be provided in which postage stamps used to make up broken amounts (not exceeding 5d.) must be affixed, and no credit will be allowed for stamps affixed on other parts of the order. These spaces will be three in number, and it will be arranged for the counter clerks selling postal orders to keep a stock of the requisite stamps. The orders will be printed on paper having a somewhat better writing surface; and orders of 10s. and upwards will be printed in red instead of blue.

The Horsfall Destructor Company, Ltd., of Leeds and London, have been awarded a Diplôme d'Honneur in Class 3—Hygiene—at the Liège Exhibition for their exhibit of refuse destructor plant.

THE TELAUTOGRAPH.

THE telautograph, as its name implies, is an instrument for reproducing hand-writing, figures, sketches, or arbitrary signs at any distance.

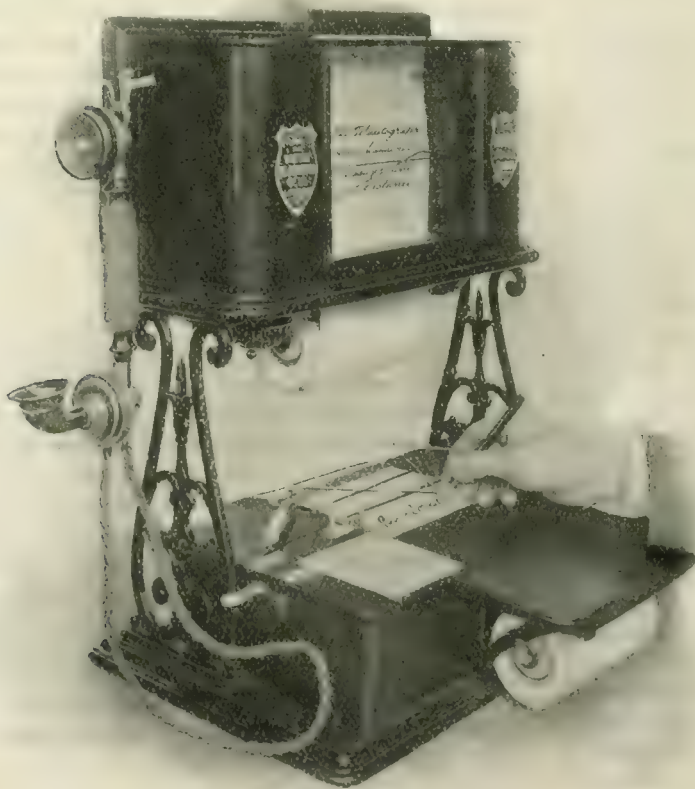
The accompanying illustration shows the instrument, and represents a complete station, the lower part being the transmitter, and the upper part the receiver. The writing is done on a roll of paper 5 in. wide, with an ordinary pencil, to which is attached metal rods. These rods operate mechanism which alters the strength

of the current sent to the line wires, according to the position of the pencil. The platen on which this paper rests has a slight vertical movement, caused by the pressure of the pencil on the paper, and will be referred to later on.

At the receiver, two motors actuated by the line currents take up positions according to the strength of the current sent through them, and, as they are connected with a pen in the same manner that the transmitting pencil is connected to its mechanism, the resulting movements of the latter must be reproduced at the receiver.

The movement of the transmitting platen referred to above, operates an electrical contact which causes the receiving pen to be either "on" or "off" the paper, in accordance with the position of the transmitting pencil. Thus records are made of the pencil's movements while on the paper only, and not of other movements made while off the paper, though the latter movements are reproduced.

The size of the writing field is 2 in. by 5 in., and when this space has been filled, the paper is shifted by the movement of the lever shown on the left-hand side of the transmitter, and the paper at the receiver is simultaneously moved forward a like amount. Thus the receiver is



THE TELAUTOGRAPH.

entirely automatic in all its movements, even to inking its pen, and messages are recorded by it whether any one is present or not. Both portions of the machine are fitted with a paper cutter, so that messages sent and received may be torn off, and filed for future reference.

Telautographs are in practical use in offices and factories for various purposes, and in some cases as many as 600 messages per day are being sent by them. There is no limit to the number of messages that can be sent, except the pace of the writer, and the number of hours the instruments are at work. The instruments are capable of working over long distances, having been successfully operated on a line of 600 miles. The messages sent have the value of a written document with the speed of the telegraph. The owners of the British patents for this invention are the Facsimile Syndicate, Ltd., of Moorgate-station-chambers, London, E.C.

Special purposes for which the telautograph is at present being used for interior service include the following :—

1. From the counting house to the different departments, or from one department to another.
2. Wherever it was previously found necessary to send messengers to various parts of the building.
3. When it is of importance that instructions should be accurately conveyed. (Ordinary messages can still be sent on the telephone, to which the telautograph may be attached).
4. The instruments being automatic at the receiving end, the person addressed, if absent, finds the message on his return. This is important in the case of directors, managers, or secretaries.
5. Sketches or diagrams are sent.
6. Orders given through the telephone, have, in most cases, to be written down somewhere. By the use of this instrument the instructions are sent through and the record made at the one operation.

LESLIE S. ROBERTSON,
M.Inst.C.E.,
SECRETARY OF THE ENGINEERING
STANDARDS COMMITTEE.

MR. LESLIE S. ROBERTSON was born in India in 1863, his father being the late Sir William Rose Robinson, K.C.S.I., at one time interim Governor of Madras. He was educated in Germany and at King's College School, London, and afterwards studied for two years, with distinction, under Professor Kennedy at University College, London. Mr. Robinson, as he was then called (the family having since resumed the original name of Robertson), carried out some original work on cast-iron beams, and was subsequently awarded a "Miller" prize by the Institution of Civil Engineers for this work. He was one of the originators and first secretary of the University College Engineering Society. On leaving college, he entered the works of Messrs. Denny and Co., Dumbarton, with whom he remained for three years. During the latter portion of his time at Dumbarton he had among other work, charge of the firm's testing department. Mr. Robertson left Dumbarton to gain experience at sea, and later entered the drawing office of Messrs. John I. Thornycroft and Co. at Chiswick. He was subsequently appointed interim works manager and soon afterwards proceeded to Havre to superintend the construction of some torpedo boats and a large number of "Thornycroft" boilers for the French Government, at the works of the Forges et Chantiers de la Méditerranée, to Messrs. Thornycroft and Co.'s designs. On the completion of this contract he visited the United States and Cuba, and in 1893 started as a consulting engineer in Westminster. He is the senior partner in the firm of Robertson and Outram, having been joined in 1898 by Mr. Frank D. Outram (late R.E.) grandson of

General Sir James Outram of Indian Mutiny fame.

Mr. Robertson has devoted considerable attention to the subject of water-tube boilers. He translated and edited the English edition of "Marine Boilers," by M. Bertin, the chief constructor to the French navy, to which edition a preface was written by Sir William White, and of which a second enlarged and revised edition is now in the press.

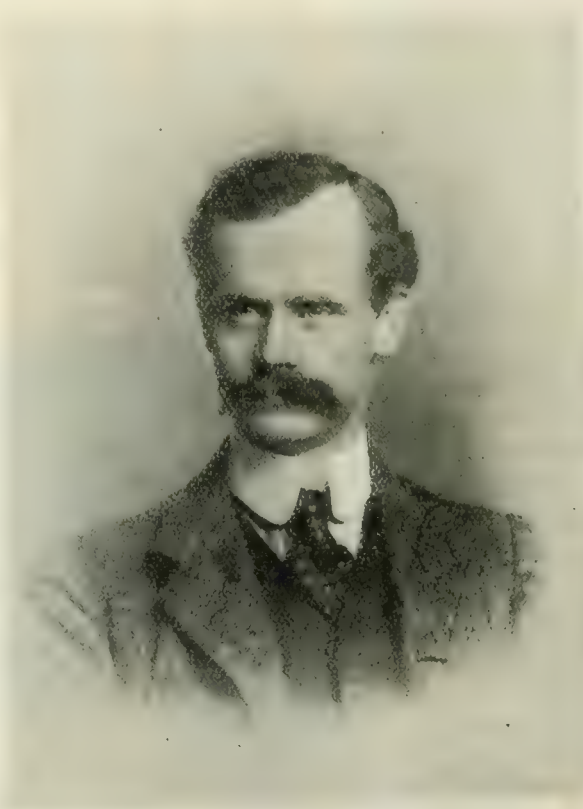
In 1902 he was requested to deliver a course of lectures on water-tube boilers at the London University College. These lectures were subsequently amplified and published in book form under the title of "Water Tube Boilers." Among other literary work he recently edited the English edition of Dr. Bauer's "Marine Engines and Boilers." Mr. Robertson is a member of the Institution of Civil Engineers, the Institution of Naval Architects and other kindred societies, to the pro-

ceedings of which he has contributed various papers on "Mechanical Propulsion in Canals," "Light Railways," etc. He superintended for the late Col. Harry McCalmont, M.P., the high speed turbine yacht *Tarantula*, fitted with Parsons' turbine engines, and Yarrow's water-tube boilers. The *Tarantula* has been described and illustrated in these columns.

In 1901, Mr. Leslie S. Robertson was appointed

secretary to the Engineering Standards Committee. Some idea of the growth and extent of the committee's operations may be gathered from the second volume of the Coded Lists, issued by permission of the Committee, and which was recently noticed in our review columns. It is stated that originally there was only one committee consisting of six members, which was subsequently

increased to fourteen. It was soon found that the work would have to be split up and dealt with by sectional and sub-committees. At present there are thirty-six different committees and sub-committees at work with a total membership of about 270. Some thirty-six different institutions and technical associations are officially represented on the various sub-committees, and their findings may be taken as the result of the deliberations of the leading technical men in the country. His



LESLIE S. ROBERTSON, M.INST.C.E.

Majesty's Government recognised at an early date the importance of the work which the committee are carrying on, and they not only asked Parliament to vote the committee a substantial grant-in-aid, but have appointed a large number of officers to assist them in their deliberations, and many of the committee's findings are being adopted by the various Government departments.

FURTHER TESTS BY THE BRITISH FIRE PREVENTION COMMITTEE.

THE testing operations with fire-resisting materials and systems of construction, conducted by the British Fire Prevention Committee last week, included tests with a floor, with ceiling slabs and with some stanchion encasements.

The floor was a French reinforced concrete floor, constructed on the Coignet system, measuring 22 ft. by 15 ft., and divided into three bays. The test was for classification as "fully protective" (Class A) which requires that fire and water shall not pass through during the test of two and a half hours' duration, at temperature reaching 1,800 deg. Fahr., followed by the application of water from a steam fire-engine for two minutes; the superimposed load being 2 cwt. per square foot. The floor attained classification, but deflected several inches. The test was carried on to three hours, the load being $2\frac{1}{2}$ cwt., i.e., under conditions exceeding those for the above classification.

The test with ceiling slabs was with 2-in. Cullum pumice slabs, applied for the protection of ordinary wood joist floors. The test was for purpose of classification as affording temporary protection (Class A), i.e., a classification requiring a test of three-quarters of an hour's duration to a temperature exceeding 1,500 deg. Fahr., followed by the application of water for two minutes. Neither fire nor water reached the wood joists and the ceiling slabs attained this classification.

The tests with the stanchion encasements, were with four stanchions protected by four different kinds of porous brick encasement (two circular, two square) on the Jabez Thompson system, the test being for classification as "fully protective" (Class A), which here requires a test of two and a half hours' duration, followed by the application of water for two minutes, the stanchions to be loaded.

Three out of the four stanchion encasements attained classification, namely, two round and one square encasement.

Official illustrated reports on these various tests are in preparation and will be issued in due course.

The whole of these tests were attended by a large representation of the membership, and visitors from Government Departments and municipal authorities.

Major-Gen. Festing, F.R.S., and Mr. W. T. Hatch M.Inst.C.E. (chief engineer the Metropolitan Asylums Board), represented the Council of the Committee, and the Directing Members of the sub-committees in charge of the respective tests were: Mr. Ellis Marsland (district surveyor); Mr. James Sheppard, A.Inst.C.E. (insurance surveyor); Mr. Oswald C. Wilson, F.R.I.B.A.; the sub-committees, as usual, comprising from three to five members.

CONCRETE AGGREGATES TEST.

The committee, in the course of last week, undertook a series of important fire tests with seven different forms of concrete in general use with a view of obtaining definite information as to their comparative fire resistance. The tests were undertaken at the Committee's testing station, preparations having been made during the past two months.

There was a large attendance of public and municipal officials. Nearly every Government Department interested was represented, and the attendance included a number of Royal Engineers' officers.

The sub-committee in charge of the test comprised Mr. Max Clarke, F.R.I.B.A. (directing member); Mr. J. Herbert Dyer (vice-president National Fire Brigades' Union); Lieut.-Col. Winn, R.E.; Mr. Walmisley, M.Inst.C.E. (Dover Harbour Board); Messrs. Dicksee and Grellier (district surveyors) Mr. C. Oswald Wylson, F.R.I.B.A.; Mr. E. J. A. Fulkes (Royal Insurance Company).

The concrete floor bays under investigation comprised bays of (1) slag concrete; (2) broken brick concrete; (3) granite concrete; (4) burnt ballast; (5) coke breeze; (6) clinker concrete; (7) Thames ballast concrete; the cement used being British "Ferro Crete" cement. The load was $2\frac{1}{2}$ cwt. per foot super.

The test was of three hours' duration at temperatures up to 1,800 deg. Fahr., followed by the application of water from two branches from a steam fire-engine for two minutes.

Pending the official detailed report, it may be stated that the general result of the test, the failure of Thames ballast concrete and the success (in order of rotation) of the clinker, coke breeze, slag, and broken brick concrete bays.

DUPLEX DRILL FOR RAILWAY WHEELS.

BY D. MITCHELL AND CO., LTD., KEIGHLEY.

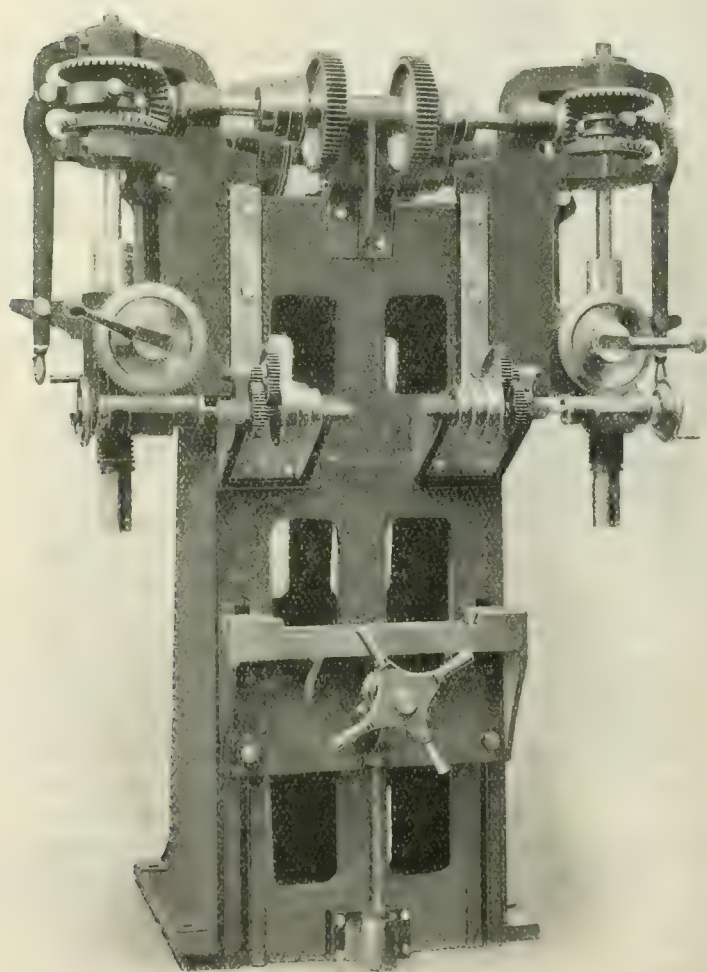
THE machine herewith illustrated has been designed for the drilling and tapping of railway wheels for the screws that hold the tyres. The spindles are $2\frac{1}{4}$ in. diameter, driven through bevel gears and reversing clutch from a horizontal top shaft. This shaft is driven through gearing with a ratio of 4 to 1, by a four-step cone, $14\frac{1}{2}$ in., $12\frac{1}{2}$ in., $10\frac{1}{2}$ in., and

$8\frac{1}{2}$ in. diameter, by $3\frac{1}{4}$ in. wide, the total gear purchase being 8 to 1.

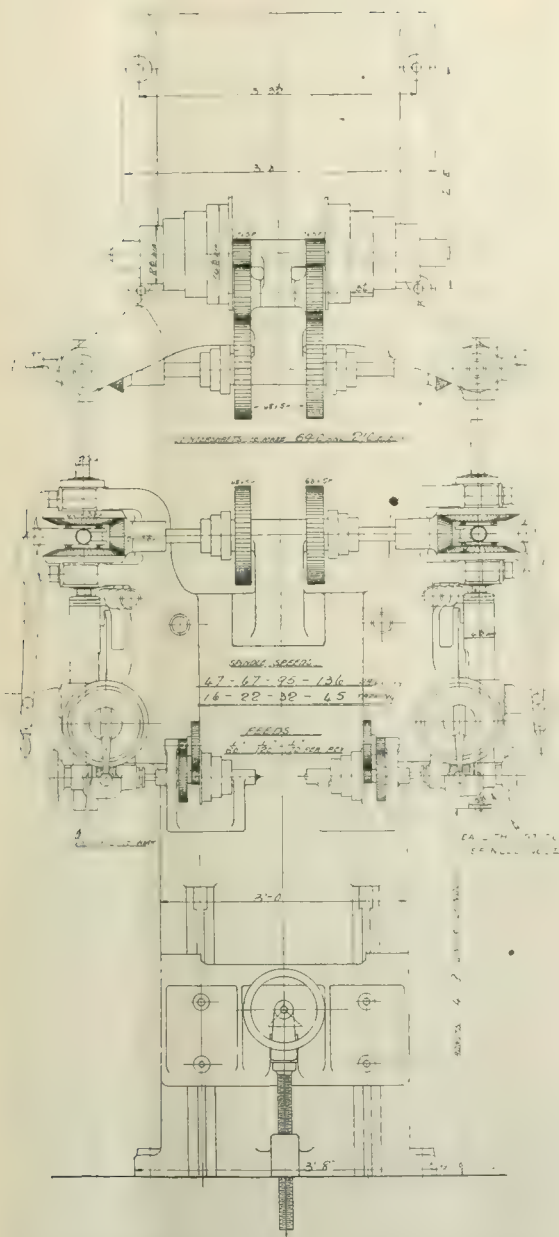
The spindles run in cast-iron sockets, which have the feed racks cut in them. They are balanced by weights inside the columns, and have ball thrusts, the spindle nose being bored to No. 5 Morse taper. The feed motion is driven from the horizontal top shaft, which

runs twice as fast as the spindle, by three-step cone, spur wheels, brass worm, worm wheel, and forged steel pinion. The feed worm has ball thrust and runs in an oil bath. The three feeds are $\frac{1}{10}$ in., $\frac{1}{12}$ in., and $\frac{1}{16}$ in., per revolution of spindle. The table has vees for holding the railway wheel axles, and may be raised and lowered to accommodate different diameters by means of a star wheel and screw.

When at its lowest position it admits 36 in. from the bottom of the vee to the spindle nose. The machine has an independent drive to each spindle, but one drive is recommended for both spindles, so that they may be drilling or tapping at the same time, the operator, whilst one is feeding through, setting the other. The counter-shaft has two speeds, viz., 640 and 210 revolutions a minute, the latter for tapping. The weight of the machine is four tons.



DUPLEX RAILWAY WHEEL DRILL.



CONSTRUCTIONAL DETAILS OF DUPLEX RAILWAY
WHEEL DRILL.

TECHNICAL EDUCATION.

Birmingham University.

An anonymous donor has promised £50,000 for the completion of the new buildings of Birmingham University at Bournbrook, this being the fourth donation of £50,000 which has been received. The other donors were Mr. Carnegie, Sir James Timmins Chance, and "Anonymously." By the latest donation, the total

fund in the possession of the council is increased to £450,000. In addition the city council have given a halfpenny rate, which is equivalent to £6,000 a year, and the county councils of Staffordshire and Worcestershire are subsidising the university to the amount of £500 a year each. The guardians of the Standard of Wrought Plate have decided to make a grant of from £200 to £300 a year. Up to the present the council have authorised an expenditure on the new university at Bournbrook of £250,000 on buildings and £100,000 on equipment.

Carnegie Technical Schools.

An event of first importance in the world of technical education is the opening of the day school of applied science in the first building completed at the Carnegie Technical Schools at Pittsburg. The particular course thus started represents but the merest fraction of the work which will be carried on when the schools are completed within the next few years. By this scheme, says the Iron Trade Review, a new era in technical education will be inaugurated. An impression has gone out that the education is to be largely in the line of manual training. This is quite incorrect. The work will be vastly more comprehensive. The instruction will be the best, the rewards to instructors being such as to invite the greatest talent. A distinct feature in the selection of instructors is the premium put upon practical experience in actual commercial work.

Teachers in Technical Institutes.

A report read at the recent meeting of the Association of Teachers in Technical Institutes recommended that steps be taken to call meetings of provincial technical teachers to lay the claims of the association directly before them, comparatively few having up to the present, joined it. Perhaps the most important matter discussed during the year had been the registration of teachers. A scheme had been drawn up by the council, and a circular had been issued to members pointing out its importance upon the future status and professional position of teachers in technical institutes. The report was adopted, and the title of the association was changed to that of "The National Association of Teachers in Technical Institutes." Mr. W. J. Lineham was elected president for the ensuing year. The council was instructed to call meetings of the teachers in provincial technical institutes to consider the following matters with full powers to act therein:—(a) The formation of local or provincial branches of the association; (b) joint action or federation with the West Riding Association of Teachers of Science, Art, and Technology, the Federation of London Teachers, and other bodies of teachers.

SHIPBUILDING NOTES.

THE *Svanholm*, second of the vessels built by Wood, Skinner and Co., Ltd., of Bill Quay, for the order of Dampskibsselskabet Steam of Copenhagen, recently left the Tyne for her official trial trip. She is of the single-deck type, with full poop and extended bridge in one, also topgallant forecastle. Water ballast is provided in the cellular bottom, and the vessel is rigged as a two-masted schooner. The propelling machinery, which has been constructed and fitted at the Northumberland Engine Works of the North Eastern Marine Engineering Company, Ltd., consists of a set of their latest type of triple-expansion engines, having cylinders 19 in., 31 in., 51 in. by 33 in. stroke, steam being supplied by two large steel multitubular boilers, working at a pressure of 180 lb. per square inch. On the trial run the vessel maintained a speed of 11½ knots.

The *Eske*, a steel screw trawler, built by Messrs. Cochrane and Sons, was launched on the 31st ult. from their shipyard at Selby. The vessel has been fitted with a whaleback and breakwater forward. She will take the highest class at Lloyd's. A large windlass, stockless anchors, Holmes trawler winch, and all the latest appliances for fishing in Icelandic waters have been fitted. The principal dimensions of the vessel are 137 ft. by 22 ft. 3 in. by 12 ft. 4 in. depth of hold. Powerful engines of the triple-expansion type are being fitted by Messrs. C. D. Holmes and Co., of Hull.

William Gray and Co., Ltd., launched on the 30th ult., the steel-screw steamer *Venus*, built for Messrs. Harris and Dixon, Ltd., London. She is of the following dimensions:—Length overall, 342 ft.; breadth, 49 ft. 2½ in.; and depth, 24 ft. 3½ in., with long bridge, poop, and topgallant forecastle. The hull is built with deep frames, dispensing with hold beams and leaving large clear holds, cellular double bottom and fore and aft peak ballast tanks, six steam winches, steam steering gear amidships, hand-screw gear aft, patent direct steam windlass, horizontal multitubular donkey boiler, shifting boards throughout, stockless anchors and telescopic masts with fore and aft rig. Triple-expansion engines are being supplied by Messrs. Blair and Co., Ltd., Stockton, having cylinders 24 in., 39 in., and 64 in. diameter, with a piston stroke of 42 in., and two large steel boilers for a working pressure of 180 lb. per square inch.

There was launched on the 28th ult., from the Wall-send yard of Swan, Hunter, and Wigham Richardson, Ltd., a steel screw steamer, which is being built to the order of E. J. Sutton and Co., of Newcastle-on-Tyne. She is of the following dimensions:—Length overall, 324 ft. 6 in.; beam extreme, 46 ft. 6 in.; depth moulded, 23 ft. 1 in.; deadweight, about 4,600 tons on a moderate draught of water. The machinery, consisting of a set of triple-expansion engines having cylinders 22 in., 37 in., and 62 in. diameter, with a stroke of 42 in., was constructed by the builders. Steam is supplied by two large single-ended boilers, working at 180 lb. pressure.

Messrs. Osbourne, Graham and Co., last week sent to sea for her official trial the s.s. *Collingwood*, a self-trimming collier for the coal trade of Messrs. Furness, Withy and Co., Ltd., of Newcastle-on-Tyne. The vessel carries 1,850 tons on a moderate draft, and her principal dimensions are: 245 ft., 33 ft. 9 in., 17 ft. 3 in. The winches, supplied by Clarke, Chapman and Co., Ltd., are placed on specially-constructed platforms to facilitate quick discharging of cargo. The engines have been supplied by Richardsons, Westgarth and Co., Ltd., of Sunderland, and have cylinders 18½ in., 30 in., 49 in. by 33 in., 180 lb. pressure, driven by one large boiler. On the trial a mean speed of over 10½ knots was attained on the measured mile, after which the *Collingwood* went into Tyne Dock to take her first cargo.

Irvines Shipbuilding and Dry Docks Company, Ltd., West Hartlepool, recently launched the steel screw passenger and cargo steamer *Siegmund* for the Dampschiffs-Rhederei "Union" Aktiengesellschaft, Hamburg. The *Siegmund* is the first of four which Irvines Shipbuilding Company have in hand for the above owners. She is intended for the North and South American trade, and is of the following dimensions: Length, 332 ft., breadth 45 ft., and depth 24 ft. 9 in., moulded, classed 100A to Germanischer Lloyd's highest class, having cellular double bottom all fore and aft, with fore and after peak tanks. Engines of the triple-expansion type are being supplied and fitted by Richardsons, Westgarth and Co., Ltd., Hartlepool, having cylinders 23½ in., 38 in., and 64 in. diameter by 42 in. stroke, steam being supplied by three large main boilers, working at a pressure of 180 lb. per square inch.

New Dredger for Newport, Mon.

Messrs. Wm. Simons and Co., Ltd., Renfrew, launched last week, completed and ready for work, a powerful 750-ton hopper dredger, constructed to the order of the Alexandra (Newport and South Wales) Docks and Railway Company. The dredger, which was put into the water complete with steam up and ready for work, has been constructed to Lloyd's highest class for a vessel of her type.

The bucket ladder, which is constructed in accordance with the builders' latest practice, and most improved form of girder work, is designed for dredging to a depth of 43 ft. below water level. The buckets are of special design and strength for dealing with the various classes of material to be met with at Newport and its approaches. The nominal bucket-lifting capacity is 900 tons per hour. The vessel is propelled by two sets of triple-expansion surface condensing engines of sufficient power to obtain a speed of about 9 knots per hour when loaded. Either set of engines is available for driving the dredging gear, and change gear is provided so that a constant piston speed can be maintained and the full power of the engines exerted, whether

the dredger is working on hard or soft material. Steam is supplied from two large marine multi-tubular steel boilers, constructed to Lloyd's requirements for 160 lb. working pressure per square inch.

A complete installation of auxiliary condensing plant is provided; also steam, fire and salvage pump, automatic boiler-feed pump, together with full outfit of engine-room auxiliaries in accordance with the best modern practice.

Independent manœuvring winches are provided at bow and stern for regulating the cut of the dredger, and independent steam hoist gear for controlling the bucket ladder, and the hopper doors are also controlled by steam appliances. The dredger is electrically lighted throughout.

The dredger has been constructed under the direction of Mr. John Macaulay, general manager to the Alexandra (Newport and South Wales) Docks and Railway, assisted by Mr. Robert Anderson, Renfrew, who acted as resident inspector.

As the dredger left the ways, she was named *Bruce* by Mrs. Macaulay, of Newport, Mon.



THE NEW 750-TON HOPPER DREDGER "BRUCE."

TRIALS OF SUCTION GAS-PRODUCER PLANT.

BY THE HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND.

A REMARKABLE RESULT.

IN July last we published the preliminary report issued on the above trials. The complete report, just to hand, is as follows :—*

The chief object which the directors had in view in conducting these trials was to afford members of the Highland and Agricultural Society and others an opportunity of becoming better acquainted with the combination of the suction gas-producer and gas engine as a cheap and convenient source of power, and at the same time to demonstrate that the suction gas-producer is a practical and simple appliance.

The Society reserved the right to test the power and working of each engine and plant as considered desirable, also to make notes and observations of the same for incorporation in an official report of the trials.

The Society provided space in the showyard, free of charge, to exhibitors submitting plants for trial.

No awards were made, and the trials were arranged so as to test the plants as nearly as possible under their ordinary working conditions.

It was suggested to intending exhibitors that each firm should submit for trial two complete plants, consisting in each case of gas-producer, scrubber, etc., and gas engine of suitable power.

The plants were to be of the following capacities :—

(a) Capacity, 15 to 20 b.h.p. at full working load.

(b) Capacity, 5 to 8 b.h.p. at full working load.

No restriction whatever was imposed upon the exhibitors with regard to the size and capacity of the generators.

Ten complete plants, exhibited by six firms, were submitted for trial. The chief particulars of these plants are given in table 1.

All the engines, with one exception, were fitted with indicator gear, and provided with revolution and explosion counters.

The indicators used throughout the trials were of the "M'Innes-Dobbie" external spring special gas engine type, supplied by Messrs. Dobbie, M'Innes, Ltd., Glasgow. The diagrams obtained were uniformly good and reliable, and show an entire freedom from vibration. At the conclusion of the trials, the indicators were carefully examined and found to be

in perfect condition—the pistons moving freely, and the parallel motions being without shake at any of the points.

Scotch anthracite "peas" from Gartshore Colliery, and supplied by Mr. James Cunninghame, 12, Waterloo Street, Glasgow, were used throughout the trials. This coal cost 9s. 3d. per ton, delivered in the showyard; it was of good quality, and none of the plants appeared to experience any difficulty in using it satisfactorily.

The coal was filled into bags from a truck, each bag containing approximately 1 cwt.

Every effort was made to have the coal thoroughly well mixed, so that each plant should be using coal of equal quality. Samples of the coal as supplied to each producer were taken, and found to be as nearly as possible of the same calorific value.

Previous to the commencement of each trial the producers were charged with sufficient coal—which was not weighed—to bring them up to their proper working condition, and the plants were required to be ready and working steadily for thirty minutes before the time of starting the trials.

In each of the power tests the time of starting was taken when the producer was filled with fuel to a pre-determined level, the ashes and clinker as far as possible having been previously cleaned out, and the engine working steadily at the stated load. At the end of the test the producer was brought as nearly as possible to the same condition as to fuel, etc., as at the start, and the fuel consumption determined from the amount introduced into the producer during this period.

At the beginning and end of each test the mass of fuel in each producer was consolidated as much as possible by working it from the top with a poker, in order to break down any arches that might have formed in the lower part of the producer.

It is a well-known fact in connection with suction gas-producers that after a few hours' run, clinker forms in the generator, and, unless broken down by bars from the outside, it is apt to cause a hollow space in the fuel bed. Great care had to be exercised in removing the ashes and any clinker from the back of the fire, to prevent the main body of the fuel in the producer from coming down. In those producers

* The report is signed by Jonathan Middleton (Steward) and R. Stanfield, M.Inst. C.E. (Engineer).

TABLE III.—TRIALS OF PLANTS OF ABOUT 8 BRAKE HORSE-POWER CAPACITY.

FULL LOAD TRIAL.				
Exhibitor	The Campbell Gas Engine Co., Halifax.	The Industrial Engineering Co., Hyde, near Manchester.	The National Gas Engine Co., Ashton under-Lyne.	Messrs. Tangy & Co., Ltd., Birmingham.
Declared B.H.P. at full working load	8	13.5	8	5.5
Duration of trial, hours	10	10	10	10
Circumference of brake wheel (effective), feet	13.33	18.57	14.26	15.19
Load on brake, lbs.	98.75	59.3	126.1	95.25
Spring balance reading, lbs.	104.9	5.0	83.5	14.50
Effective load on brake, lbs.	87.85	54.3	102.6	80.75
Revolutions per minute, mean	232.5	204.9	219.9	220.5
Brake horse-power	9.35	9.72	9.74	8.34
Diameter of cylinder, inches	7.5	11.5	15	16
Stroke, inches	12	14	15	16
Mean effective pressure, lbs. per sq. in.	77.8	77.8	83.8	75.8
Explosions per minute, mean	100.4	92.1	97.2	92.1
Indicated horse-power	9.66	11.88	10.83	10.83
Mechanical efficiency, per cent	85.4	82.0	82.0	76.6
Total coal used, lbs.	101.75	110.25	82.0	100.5
Coal per B.H.P. per hour, lb.	1.22	1.13	0.84	1.25

HALF LOAD TRIAL.

Exhibitor	The Campbell Gas Engine Co., Halifax.	The Industrial Engineering Co., Hyde, near Manchester.	The National Gas Engine Co., Ashton under-Lyne.	Messrs. Tangy & Co., Ltd., Birmingham.
Duration of trial, hours	10	8.43	10	10
Circumference of brake wheel (effective), feet	18.33	18.57	14.26	15.19
Load on brake, lbs.	50.0	37.6	64.0	45.5
Spring balance reading, lbs.	9.7	2.0	7.1	4.1
Effective load on brake, lbs.	40.3	35.6	56.9	41.4
Revolutions per minute, mean	236.8	217.4	225.36	220.5
Brake horse-power	4.43	4.36	4.57	4.57
Mean effective pressure, lbs. per sq. in.	76.3	76.3	76.3	76.3
Explosions per minute, mean	75.2	75.2	75.2	75.2
Indicated horse-power	6.41	6.97	7.49	7.49
Mechanical efficiency, per cent	69.1	63.7	63.7	63.7
Total coal used, lbs.	41.5	56.75	49.0	47.5
Coal per B.H.P. per hour, lb.	0.94	1.55	0.91	1.48
Average coal consumption per B.H.P. per hour on full and half load trials combined, lb.	1.12	1.26	0.87	1.30
Capacity of producer per declared B.H.P., cub. ft.	0.582	0.181	0.372	0.212
Remarks on trials	Completed full trial without a stop. During the half load trial the producer was re-ignited as the engine was stopped for a few seconds to replace a pin in the ignition gear.	Completed full trial without a stop. During the half load trial the producer was re-ignited as the engine was stopped for a few seconds to replace a pin in the ignition gear.	Completed full trial without a stop. During the half load trial the producer was re-ignited as the engine was stopped for a few seconds to replace a pin in the ignition gear.	Completed full trial without a stop. During the half load trial the producer was re-ignited as the engine was stopped for a few seconds to replace a pin in the ignition gear.

* 6 lbs. and 3.5 lbs. added to observed consumption for presence of clinker at end of full and half load trials respectively. Total clinker and ash collected at the end of the three load trials = 12 lbs.

TABLE II.—TRIALS OF PLANTS OF ABOUT 20 BRAKE HORSE-POWER CAPACITY

FULL LOAD TRIAL.				
Exhibitor	The Campbell Gas Engine Co., Halifax.	Messrs. Crossley Bros., Ltd., Manchester.	The National Gas Engine Co., Ashton under-Lyne.	Messrs. Tangy & Co., Ltd., Birmingham.
Declared B.H.P. at full working load	18	16	20	19
Duration of trial, hours	10	8.12	10	10
Circumference of brake wheel (effective), feet	17.44	14.49	18.46	17.67
Load on brake, lbs.	225.0	197.0	206.75	206.75
Spring balance reading, lbs.	24.0	184.2	190.5	11.69
Effective load on brake, lbs.	201.0	188.2	190.5	195.06
Revolutions per minute, mean	204.4	153.35	205.7	19.98
Brake horse-power	18	20	18	10
Diameter of cylinder, inches	18	20	18	10
Stroke, inches	18	20	18	10
Mean effective pressure, lbs. per sq. in.	75.6	75.6	75.6	75.6
Explosions per minute, mean	78.4	78.4	78.4	78.4
Indicated horse-power	23.73	23.73	23.73	23.73
Mechanical efficiency, per cent	86.1	84.1	85.6	85.3
Total coal used, lbs.	190.0	190.0	190.0	190.0
Coal per B.H.P. per hour, lb.	0.93	0.77	0.80	0.83

HALF LOAD TRIAL.

Exhibitor	The Campbell Gas Engine Co., Halifax.	Messrs. Crossley Bros., Ltd., Manchester.	The National Gas Engine Co., Ashton under-Lyne.	Messrs. Tangy & Co., Ltd., Birmingham.
Duration of trial, hours	10	10	10	10
Circumference of brake wheel (effective), feet	17.44	14.49	18.46	17.67
Load on brake, lbs.	127.25	136.75	133.9	101.0
Spring balance reading, lbs.	24.10	32.50	38.5	18
Effective load on brake, lbs.	103.15	104.25	95.4	83
Revolutions per minute, mean	10.60	9.06	10.48	10.72
Brake horse-power	7.56	7.78	7.78	7.78
Mean effective pressure, lbs. per sq. in.	53.4	53.4	53.4	53.4
Explosions per minute, mean	15.12	13.0	14.76	15.0
Indicated horse-power	70.7	71.0	73.5	73.5
Mechanical efficiency, per cent	98.0	87.25	110.0	110.0
Total coal used, lbs.	0.92	0.96	0.95	1.08
Coal per B.H.P. per hour, lb.	0.93	0.86	0.86	0.92
Average coal consumption per B.H.P. per hour on full and half load trials combined, lb.	0.93	0.86	0.86	0.92
Capacity of producer per declared B.H.P., cub. ft.	0.232	0.270	0.295	0.124
Remarks on trials	Completed both trials without a stop.	Completed both trials without a stop.	Completed both trials without a stop.	Completed both trials without a stop.

* 10 lbs. and 7 lbs. added to observed consumption for presence of clinker at end of full and half load trials respectively. Total clinker and ash collected at end of the three load trials = 30 lbs.

TABLE I.—GENERAL DIMENSIONS AND PARTICULARS OF PLANTS ENTERED FOR TRIAL.

PLANTS OF ABOUT 20 BRAKE HORSE-POWER CAPACITY.

Exhibitor	The Acme Engine Co., Shettleston, Glasgow.	The Campbell Gas Engine Co., Halifax.	Messrs Crossley Bros., Oldham, Manchester.	The Industrial Engineering Co., Hyde, near Manchester.	The National Gas Engine Co., Ashton-under-Lyne.	Messrs Tangyes, Ltd., Birmingham.
Declared capacity of gas-producer plant, B.H.P.	25	18	24	25	20	21
Price of gas-producer plant, complete	£94, 10s.	£105	£80	£72	£80	£80
Total weight of plant, cwts.	35	25	45	25	25	28
General description of engine	"Acme"	"Campbell"	"Crossley"	"Acme"	"National"	"Tangye"
Declared brake horse-power of engine	22	18	16	22	20	19
Diameter of cylinder, inches	10	9½	8½	10	10	10
Stroke, inches	17	18	20	17	18	19
Revolutions per minute, declared	220	200	200	220	190	190
Price of engine, complete	£130	£125	£110	£130	£120	£131
Weight of engine, cwts.	60	66	54	60	78	69
Price of producer plant and engine, complete	£224, 10s.	£230	£190	£202	£200	£221
Space taken up by complete plant—producer, engine, &c., sq. ft.	144	225	240	288	225	225

PLANTS OF ABOUT 8 BRAKE HORSE-POWER CAPACITY.

Exhibitor	The Campbell Gas Engine Co., Halifax.	The Industrial Engineering Co., Hyde, near Manchester.	The National Gas Engine Co., Ashton-under-Lyne.	Messrs Tangyes, Ltd., Birmingham.
Declared capacity of gas-producer plant, B.H.P.	8	10	10	12
Price of gas-producer plant, complete	£80	£60	£65	£58
Total weight of plant, cwts.	25	15	20	17
General description of engine	"Campbell"	"Acme"	"National"	"Tangye"
Declared brake horse-power of engine	8	13½	8	7½
Diameter of cylinder, inches	7	8½	7	7
Stroke, inches	12	14	15	16
Revolutions per minute, declared	230	230	220	220
Price of engine, complete	£80	£75	£80	£90
Weight of engine, cwts.	29	25	40	40
Price of producer plant and engine, complete	£160	£135	£145	£148
Space taken up by complete plant—producer, engine, &c., sq. ft.	160	158	225	160

TABLE IV.—TRIAL TO ASCERTAIN THE TIME REQUIRED TO GET UP EACH PLANT TO FULL WORKING LOAD, STARTING WITH THE GAS-PRODUCER EMPTY AND COLD.

Exhibitor.	Declared capacity of plant, B.H.P.	Time taken—minutes.	Remarks.
The Campbell Gas Engine Co.	18	13	
Do. do.	8	17½	
Messrs Crossley Bros.	24	15½	
The Industrial Engineering Co.	10	..	
The National Gas Engine Co.	20	48	Started, but was compelled to stop through water being shut off at main.
Do. do.	10	15½	Excessive time caused by defective ignition. More than two men were employed to start engine.
Messrs Tangyes, Ltd.	21	16	
Do. do.	12	12½	

which were provided with two or more doors on the grate level this difficulty was not so serious.

Some designers of suction plants hold that the anthracite in the lower part of the producer should be disturbed as little as possible; but with a low-class quality of fuel, liable to clinker, it is obvious that some adequate provision should be made for readily removing the clinker, etc.

Any unburnt fuel that was unavoidably extracted while clinkering was carefully picked out and returned to the producer.

In spite of every precaution that could be taken, it was felt that certain errors of measurement with regard to fuel consumption were possible, and on that account the results given later should be taken as tentative.

Each plant was required to undergo a full and half-power trial of not less than ten hours' duration, also a light load trial for a period of five hours.

It was also stipulated that not more than two men would be allowed to look after and attend to each plant (producer and engine).

By making the duration of each power trial ten hours, it was considered that any error in arriving at an estimate of the fuel consumption would be minimised; at the same time, in view of the very small amount of coal used in the majority of the plants, it is necessary to draw attention to the fact that the fuel consumption obtained may be slightly under the true value, though the degree of error cannot be large.

In the light load test the coal consumption was

not measured, as the object was rather to ascertain the capabilities of the producers to supply gas to the engines when running without any load.

All the plants that were tested completed this light load trial satisfactorily.

If they desired, exhibitors were allowed to remove any ashes or clinker from the producers in the course of and at the end of the full, and of the half-load trials. This was done with all the producers except the Dowson producers, which were worked by the National Gas Engine Company, and which were not cleaned out till the close of the third test.

At the end of the power and light-load trials all the producers were thoroughly emptied and an examination made for clinker. It was originally intended to weigh the ashes and clinker, but, unfortunately, on account of an accident this became impracticable.

On the whole, it was considered that the total amount of clinker formed during the trials was practically the same in each plant. The amount was very small, and did not appear to have any disadvantageous effect on the working of any of the plants.

In arriving at an estimate of the coal consumption of the National Gas Engine Company's plants, it was felt that owing to the clinker not having been removed from the producers at the end of the full and half-load trials, a certain amount should be added on to the observed consumption. This has been done. The efficiency of the plants is in no way detracted from by this.

After the producers had been emptied and allowed to cool, a further test was made to ascertain the length of time required to get up to full working load, starting with the producer empty and cold. The time occupied was taken from the moment of inserting the firewood until the engine was carrying the same load as during the full power trial, and this load it was required to sustain for twenty minutes.

The average time required for this test seemed to be about fifteen minutes. A tabulated list of the times taken by the various plants is given later.

Two of the plants—The Acme Engine Company and The Industrial Engineering Company (large plant)—were not subjected to any complete tests. This was, no doubt, due to the fact that the engines had not been properly tested before being erected in the test shed, and in consequence they stopped running on several occasions owing to defective ignition and other causes. So far as could be ascertained, the stoppages in these two plants were not due to any defect in the gas-producer.

The plant supplied by Messrs. Crossley Bros did not complete the full power trial owing to the pro-

ducer failing to supply gas, and it was compelled to stop at the end of 8 1/2 hours. This is greatly to be regretted, as the plant was doing good work, and no doubt it could have completed the trial satisfactorily but for an error of judgment on the part of the attendant with regard to the manipulation of the plant.

The small plant exhibited by the Industrial Engineering Company, after having satisfactorily completed the full power trial, was compelled to stop on the half-load trial after running for 8.43 hours. This was attributed to the presence of moisture on the igniting points in the engine, but it was practically impossible to arrive at any satisfactory conclusion on the matter. Considering that this plant completed the full power and light-load trials without a stop, it is not likely that the stoppage, on the occasion referred to, was due to any defect in the producer, but rather to a want of proper attention to the working of the engine.

There were momentary stoppages on some of the other plants. These were mainly caused by engine troubles, and cannot be looked upon in a serious light.

With the above-mentioned exceptions, none of the plants experienced any real difficulty in running for the specified period of ten hours—in fact, there is no doubt that they could easily have worked quite well for a much longer time.

The amount of attention which these plants require is remarkably small, very little labour being necessary for cleaning and stoking. Working under ordinary conditions—not a test—it is not considered that it would have been necessary to clean out the ashes and clinker except, perhaps, at the end of each day's run; this, in any case, is a simple operation, which can be performed in a few minutes, and does not require the presence of a special attendant.

All the producers were provided with doors for removing any accumulation of ash and clinker.

On the whole, the results of the trials were most satisfactory, and the economy, efficiency, and simplicity of working of the suction gas-producer plant was demonstrated beyond question.

On the combined trials at full and half-load (twenty hours altogether), the average coal consumption for all the plants was about 1 lb. of coal per brake horsepower per hour, costing about one-twentieth of a penny—coal at 9s. 3d. per ton.

This is a remarkable result; it means that an engine developing 20 b.h.p. can be run at a cost of about one penny per hour.

Considering the manifest difficulties in arriving at strictly accurate results, no attempt has been made to place the various plants in any order of merit. For the combined trials the coal consumption for the

large engines is practically the same for all plants, the greatest variation is to be seen in the coal consumption of the small plants—0.87 to 1.30 lb. per b.h.p. per hour. This was to be expected.

A rather curious point occurs with regard to the results as obtained from the trials of the Campbell Gas Engine Company's plants. The coal consumption per brake horse-power per hour is less on the half-load than on the full load trial. This is obviously the opposite from what should be the case, and it may be due to the fact that the fires in the producers in these two plants were not lighted until the morning of the first test, whereas the other plants had their producers in working order the night previously. This would naturally mean that a quantity of fuel was expended in heating up the walls of the producer. It is also

possible that a difference in the degree of "clinkering" in the two trials might to some extent account for the discrepancy. No other explanation seems to be available, as all the weights of fuel used were very carefully checked.

It would be unjust to draw any invidious distinctions between the various plants. Without exception they are simple in construction, and every detail both in engine and gas-producing plant has evidently been carefully considered with a view to giving the best results. The committee feel that they have performed the task which they undertook—viz., of demonstrating publicly the economy and workability of the suction gas-producer plant.

The results of the various trials are shown in the accompanying tables.

IRON ORE DEPOSITS ABROAD.

POSSIBLE FIELDS FOR FUTURE ENTERPRISE.

(Continued from page 1005.)

NEW ORLEANS.

Birmingham has good railroad facilities. Five trunk lines furnish communication with the outside world, viz., : The Louisville and Nashville, four directions; Southern, two directions; the 'Frisco system, one direction; Central of Georgia, one direction; while the Birmingham Mineral Railroad, the Birmingham Southern and the Belt line girdle the city, and tap every main line, reaching every factory mill, furnace and quarry and mine in the district, delivering raw materials to the factories and finished products to the trunk lines and open up territory for development.

Since January, 1900, there has been built in the district 200 miles of main lines and spur tracks.

When the improvements now being made by the Government on the Warrior and Tombigbee Rivers are completed, they are destined to play an important part in the transportation of coal and other heavy products from the Birmingham district to tide water at Mobile.

With 24 ft. of water over the bar at Mobile this route would be the means of reducing the cost of transportation to the Atlantic seaboard.

The distance from Birmingham to Mobile is 258 miles.

IN UTAH.

Mr. A. C. Milner, of Salt Lake City, reports:—The iron properties in Iron County, South-Western Utah, are situated in Iron Mountain and Iron Springs Districts, which are about 22 miles south-east of the Oregon Short Line Railroad.

The deposits cover an area fifteen miles long by about three miles wide, the ore showing on the surface at three different points. The ore is principally a soft red and brown hematite, which can be handled easily by steam shovel, except where blow-outs occur, which are hard and magnetic. Hundreds of acres will require only from 1 ft. to 3 ft. of stripping. Mr. R. B. Dear, of the firm of Winston Bros., and Dear, Duluth, estimated that ore can be stripped, mined and put on cars for 15 cents per short ton (2,000 lb.).

There are apparently three separate veins, the largest being 800 ft. between walls, second about 500 ft., and third 200 ft. The largest vein has been developed along the strike for about 15,000 ft., and the 500 ft. vein for about 12,000 ft., and the 200 ft. vein for about 5,000 ft.

The development work has been done principally by pits and shafts, there being about 1,500 of them. There are also numerous trenches and tunnels; the deepest shaft is 150 ft. About \$125,000 has been expended in this work. The ore occurs between lime and granite, foot-wall being granite and hanging wall lime.

VAST EXTENT OF DEPOSITS.

Various iron experts who have made examination of these properties state that it is the largest surface of iron ore in the world. The tonnage in sight is so great that it is very difficult to state what it is, but the various experts have made estimates from 100,000,000

to 500,000,000 short tons. They also stated that the possibilities of the deposit were from 800,000,000 to 1,000,000,000 short tons. About 25 per cent. of this ore is Bessemer, the balance being basic. By mixing the two ores, the percentage of Bessemer would be much increased.

The ore runs an average of about 60 per cent, metallic iron. The average in silica is about 7 per cent. The limestone adjacent to the iron has all proper fluxing qualifications necessary in furnace work.

The coal measures in Caribou County produce a coke which is equal to the Connelsville article, both as regards analysis and strength necessary to carry furnace burden; this coal is about 225 miles from the iron on the Rio Grande Western Railroad.

The iron fields are 273 miles from Salt Lake City, and 445 miles by Clark Road Survey from San Pedro Harbour, which is the Pacific coast terminus of the Clark Road.

This combination controls 124 claims or locations, 109 being patented and 15 unpatented. These claims cover about 2,800 acres, which take in about 85 per cent. of the iron in sight.

COST OF MANUFACTURE.

Experts figure that pig iron can be manufactured in Utah for \$6 per ton, and that steel rails can be made for \$13 per ton.

The Colorado Fuel and Iron Company, at Pueblo, Colorado, are the only pig iron and steel manufacturers west of the Mississippi River, and their cost per ton is high, as all their raw materials are hauled from considerable distances, Arizona, New Mexico, Wyoming, etc., to point of manufacture, which is 1,400 miles from the Pacific coast, and 900 miles further from the coast than Utah iron, and thus could not compete with an iron and steel plant in Utah for the Pacific coast and Oriental iron and steel business.

Pig iron sells at Salt Lake City at \$38 to \$42 per ton, San Francisco, \$34 to \$38; steel rails, Salt Lake, \$46, San Francisco, \$48 (not to-day). Annual consumption of steel rails on Pacific coast is about 300,000 tons, pig iron, 480,000 tons. Consumption could be much increased if iron products could be obtained from Utah cheaper. This iron field developed will eventually control the Pacific coast and Oriental iron and steel business, if properly manipulated. The Orient is the future great market for many manufactured commodities, among which iron and steel are the principals. Any one visiting the iron mines must leave the Oregon Short Line at Lund, Iron County.

A much more elaborate description of the iron ore and its possibilities could be given. The above includes the principal facts.

It may be further stated that there are no other known iron deposits in the west that are of sufficient extent to be considered as the basis for developing an iron and steel enterprise.

The owners, it is believed, would be disposed to accept a good offer in many instances, although the mines are not actually in the market.

VENEZUELA.

Very extensive iron-ore deposits are reported to exist in the consular district of Ciudad Bolivar. Mr. Consul de Lemos reports: They are situated on the south side of the Orinoco River at Imataca, near the mouth of the river. There is no established shipping port, but there is a convenient shipping place with deep water, where ocean steamers which can pass the Orinoco bar, 16 ft., can lie alongside. This shipping place is in close proximity of the ore deposits.

The cost of transport of the ore to the shipping place would therefore be small. It could be effected either by a tram line or by overhead wire rope.

The labour for mining, etc., would have to be imported, as none is available locally. For this purpose a supply can easily be obtained from the West Indian Islands. The wages would probably be about 4s. a day for miners and quarrymen, and 25 per cent. less for common labourers.

No official analyses of the ore are obtainable here. Experts who have visited the mines have stated that the ore is of an exceptionally high quality, containing 70 per cent. of metallic iron, and that it is almost, if not quite, free of sulphur and phosphorus. One expert qualified it as "specular" iron ore, capable of being treated with a small quantity of fluxes.

Concessions on the iron-ore deposit referred to have been granted to different parties, who have been negotiating for a long time to form companies. The concessionaires are not rich, and likely to be sellers of deposits on reasonable terms.

Work on a small scale has been done on some of the deposits, and one or two sample cargoes were shipped a few years ago. No statistics are, however, available.

The iron-ore deposits in the Imataca Range of mountains have not yet been properly explored, and it is believed that other deposits besides those already known could be discovered. So far, only outcrops in the immediate neighbourhood of the Orinoco River have received attention.

The titles and concessions already issued have given rise to several lawsuits and disputes, while difficulties have been placed in the way of vessels loading at Imataca. This has no doubt impeded the development of these mines, which certainly appear to be of great value and importance.

THE RETURN-PIPE SYSTEM OF COMPRESSED AIR POWER TRANSMISSION.

BY H. C. BEHR.

THE inconvenient arrangements required in order to secure efficiency with the ordinary method of using compressed air, i.e., when high ratio of pressure limits are used, led Charles Cummings, of San Francisco, California, to devise the Return-Pipe or Dense-Air System.

The Cummings system, as the writer prefers to call it, both for the sake of brevity and also in justice to the inventor, is very little known, excepting through a few meagre references and descriptions given in some of the technical journals. The system, however, deserves more than a passing notice. It has some characteristic features which have, perhaps, not been touched upon before. With care in design and maintenance, high efficiency is obtainable with it, while, at the same time, it is flexible and convenient for nearly all purposes except the running of drills.

The Cummings system operates in a close circuit. The air, delivered from the compressor at a given working pressure, is conducted to the engine to be operated, from which it is exhausted at a lower pressure, but at the same time much higher than that of the atmosphere. It is brought back at that pressure through a return pipe to the inlet of the compressor cylinder in which it is re-compressed to the operating pressure and again forced into the supply pipe leading to the engine. The same air, therefore, circulates through the system continuously.

The fundamental feature of the Cummings system is thus the maintenance of what might be termed an artificial atmosphere in a return pipe connecting the exhaust of the engine with the intake of the compressor, thereby constituting a closed system.

Fig. 1 illustrates schematically a supposed application of the system to the operation of an underground pumping plant in a mine. The dense-air compressor a, driven by the engine b, at the surface delivers the air under a pressure of, say, 170 lb. absolute, through the main c to the cylinder of the dense air engine d, driving the pump e at the station underground; h is the suction pipe from the sump, and g the pump column leading to the surface. The air exhausted from the engine underground at a pressure of, say, 85 lb. absolute, is conducted at about this pressure through the return main f to the inlet of the compressor a at the surface.

In comparison with the ordinary system, even when compression is performed in stages, the rise in temperature due to compression and subsequently the contraction in volume of the air as delivered to the engine, will be relatively small. The comparatively small drop in temperature during expansion in the engine cylinders also enables this part of the work generally to be fully utilised without danger of freezing up, thus obviating the need of reheating. Compound compression and expansion are, therefore, unnecessary, and it is evident that a comparatively high efficiency may be reached by this system of power transmission without the inconvenience and complication inseparably associated with the ordinary system when light efficiency is required. By proper construction and care in maintenance, leakage can be reduced to an insignificant amount. At any rate, a very small compressor will suffice to force into the return main the make-up air required to compensate for leakage.

In fig. 2 such a small compressor *i*, suitable for this purpose, is shown with the delivery pipe *k* connected to the return main *f*.

Moisture will be precipitated from the air in the power main before reaching the engine. It may be drawn off periodically by the attendant, or automatically by means of a trap. The air would then be dried in the process since it is always the same air which is being used, excepting any small amount that may be introduced to make up for leakage.

In the case of pumping, an incidental advantage of a closed system like the Cummings is, that the pumps can be operated when submerged to great depth, the same as with hydraulic pumping engines or with the Cornish system.

COMBINATION WITH PRESE SYSTEM OF AIR SUPPLY FOR DRILLING.

In applying the Cummings system to mining work there would be an apparent advantage in combining it with the present system of air supply for drilling. Part or all of the air from the drill compressor at the surface may be passed through the

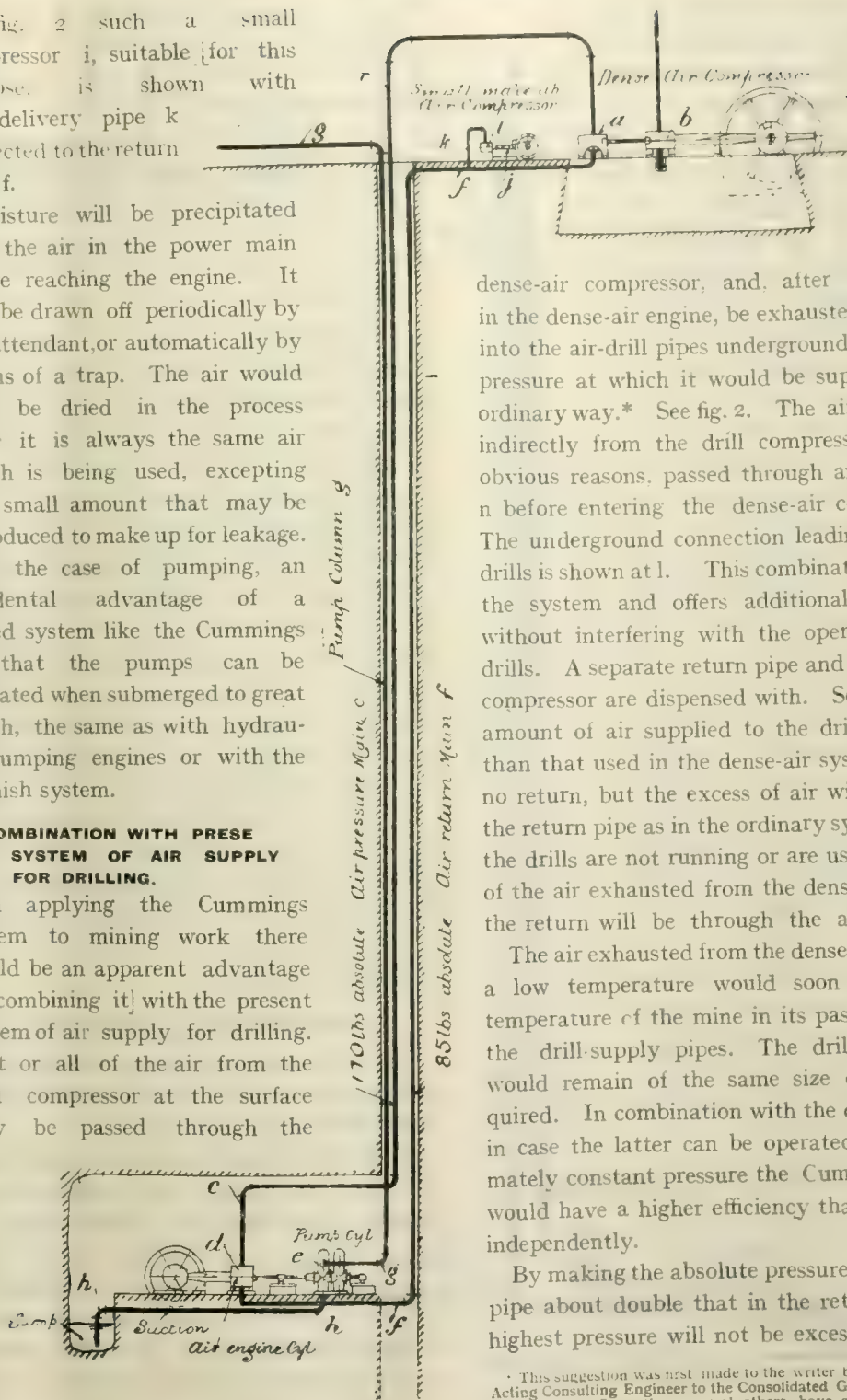


FIG. 1.

dense-air compressor, and, after doing work in the dense-air engine, be exhausted from there into the air-drill pipes underground at the same pressure at which it would be supplied in the ordinary way.* See fig. 2. The air thus taken indirectly from the drill compressor *i* is, for obvious reasons, passed through an intercooler *n* before entering the dense-air compressor *a*. The underground connection leading off to the drills is shown at *l*. This combination cheapens the system and offers additional advantages without interfering with the operation of the drills. A separate return pipe and the make-up compressor are dispensed with. So long as the amount of air supplied to the drills is greater than that used in the dense-air system, there is no return, but the excess of air will flow down the return pipe as in the ordinary system. When the drills are not running or are using only part of the air exhausted from the dense-air system, the return will be through the air-drill pipe.

The air exhausted from the dense air system at a low temperature would soon acquire the temperature of the mine in its passage through the drill-supply pipes. The drill compressor would remain of the same size otherwise required. In combination with the drilling plant, in case the latter can be operated at approximately constant pressure the Cummings plant would have a higher efficiency than if operated independently.

By making the absolute pressure in the supply pipe about double that in the return pipe, the highest pressure will not be excessive, while at

* This suggestion was first made to the writer by Mr. R. M. Catlin Acting Consulting Engineer to the Consolidated Gold Fields of South Africa, Ltd. Since then several others have suggested the same arrangement.

the same time the rise in temperature through compression will only be moderate, even with adiabatic compression.

REGULATING DEVICE.

The ratio of pressures is maintained uniform in the executed examples of the Cummings system by a regulating device having two connected pistons, one exposed to the pressure in the high-pressure main, and the other to that in the return main. Any variation in the demand for power will at once vary the ratio of pressures and will move the pistons in one or the other direction. The pistons transmit their motion to a throttle valve or to the cut-off gear on the engine driving the compressor, so as to cause it to vary its speed to suit the demand for power. A uniform ratio of pressures demands that both the supply and the return pressure be maintained constant. The return pressure can be maintained in the same way as the pressure in the ordinary air plants. If the return pressure varies, the pressure in the supply pipe, and the difference or operating pressure would vary in proportion. If such vari-

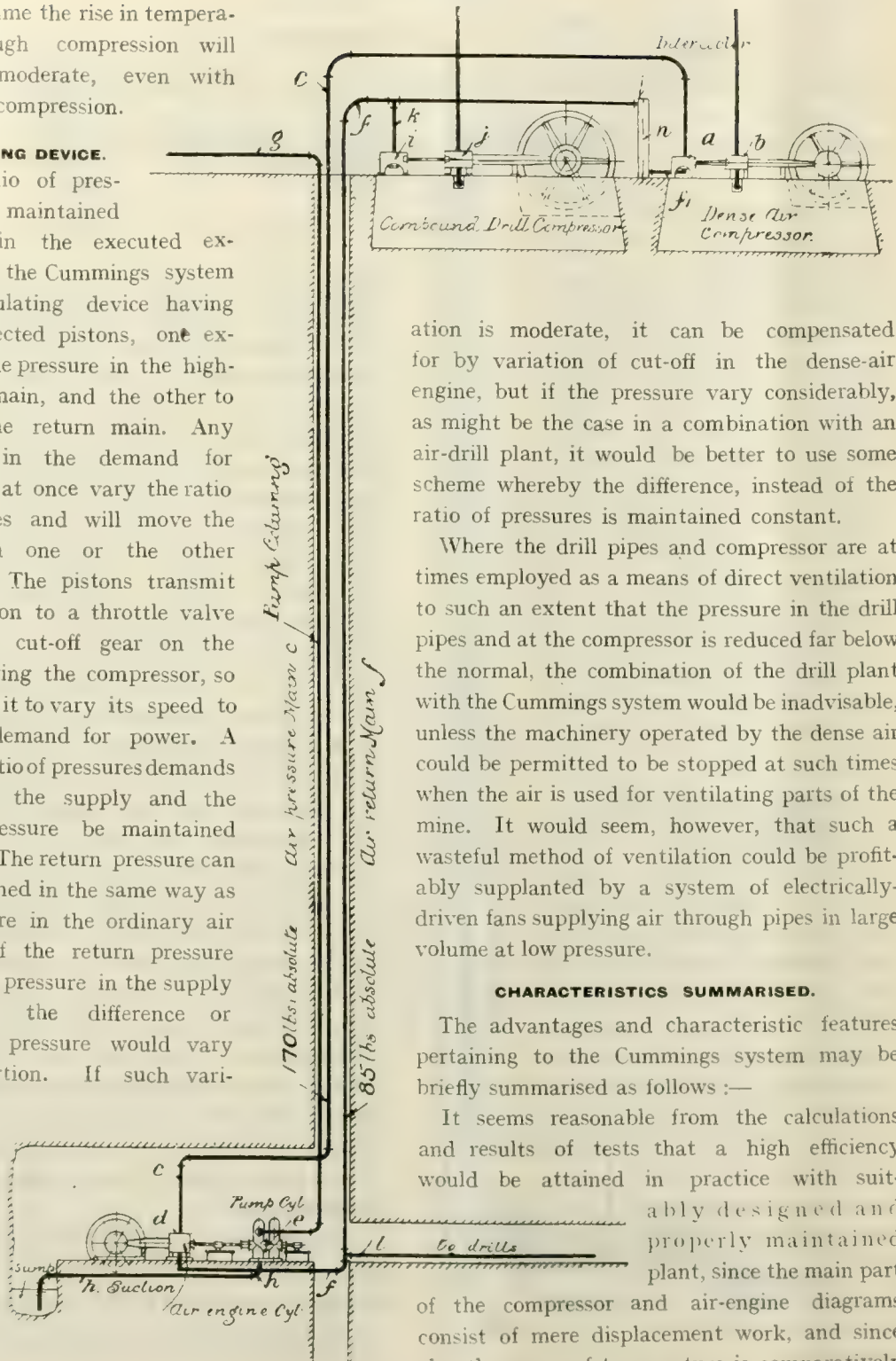


FIG. 2.

ation is moderate, it can be compensated for by variation of cut-off in the dense-air engine, but if the pressure vary considerably, as might be the case in a combination with an air-drill plant, it would be better to use some scheme whereby the difference, instead of the ratio of pressures is maintained constant.

Where the drill pipes and compressor are at times employed as a means of direct ventilation to such an extent that the pressure in the drill pipes and at the compressor is reduced far below the normal, the combination of the drill plant with the Cummings system would be inadvisable, unless the machinery operated by the dense air could be permitted to be stopped at such times when the air is used for ventilating parts of the mine. It would seem, however, that such a wasteful method of ventilation could be profitably supplanted by a system of electrically-driven fans supplying air through pipes in large volume at low pressure.

CHARACTERISTICS SUMMARISED.

The advantages and characteristic features pertaining to the Cummings system may be briefly summarised as follows:—

It seems reasonable from the calculations and results of tests that a high efficiency would be attained in practice with suitably designed and properly maintained plant, since the main part of the compressor and air-engine diagrams consist of mere displacement work, and since also the range of temperature is comparatively small, thus enabling in general the complete

utilisation of the work of expansion without the necessity of reheating the air. It seems also legitimate to assume that the air would be less heated on introduction into the compressor cylinder than in the ordinary system, since the metal is at a much lower temperature, and that the result would be additional increase of efficiency.

By sacrificing, in the case of a pumping plant, the work of expansion—either wholly or in part—the efficiency, at full pressure for full stroke, would still be such as to warrant operation with simple direct-acting pumps as a provisional arrangement, for which such pumps are much used—even with the ordinary wasteful system—on account of their simplicity and the facility of installation, and the promptness with which they can generally be supplied. In many cases it may be good economy to use the system with direct-acting pumps correctly proportioned to the work, even for permanent installations.

The air machinery, both at the surface and below ground, in the Cummings system is of simple design, requiring only ordinary mechanics for attendance and maintenance.

As in any compressed air system, the machinery may be operated at any speed within wide limits without appreciably affecting the mechanical efficiency and economy. In the case of a pumping plant, ability to increase the speed—and thereby the capacity—would be particularly useful to meet increase of water.

Underground pumps and winders can be operated by one and the same system. Where underground plant is thus operated it might be economy to extend the system to the operation of the surface winders. These would then only require to be simple engines, which are more easily handled than the compound type. Such surface winders could, however, also at once be operated at short notice by steam, whenever necessary through any stoppage of the air plant, thus affording the same guarantee for continuity of operation as the ordinary steam-winder plant.

The underground winders being of the ordinary type like those operated by steam, the same class of attendants, requiring no special training, would be available for their operation.

The underground pumping plant can be arranged to operate under water, as when the level of the pump is drowned out. This is a particularly valuable feature for operation of sinking, or lowest-level pumps.

By combination with the ordinary air-drill plant the efficiency of the Cummings system can be increased without detriment to the efficiency of the drill plant.

The absence of reheating makes attendance at the underground stations most convenient and endurable.

Reheating may, however, be applied in case of need to provide for the operation at higher speed of the underground plant, or for an extension to the latter, without the necessity of increasing the speed of, or adding to, the surface plant or air mains.

There is less danger from explosions than in the ordinary system, owing to the lower temperature of compression.

In winders operated by the Cummings system the variation in economy with variation of cut-off and speed would be much less than in a steam-winder, or even a winder operated by reheated air.

Abstract of a paper read at a meeting of the Transvaal Institute of Mechanical Engineers.

SOUTH AFRICAN ENGINEERS.

THE following names have been added to the membership roll of the Chemical Metallurgical and Mining Society of South Africa:—W. G. Brunton, Premier Diamond Mine, Pretoria; G. S. Evans, Sabiwa Mine, Gwanda, Rhodesia; W. F. Graham, P. O. Box 4331, Johannesburg; A. D. Newman, Messrs. Fraser and Chalmers, Ltd., Box 619, Johannesburg; R. C. Nicolaus, Messrs. Mercer, Nicolaus and Co. (London), P. O. Box 3443, Johannesburg; W. F. Parker, City and Suburban G. M. Co., Ltd., P. O. Box 1026, Johannesburg; F. B. Stephens, P. O. Box 76, East Rand; G. E. Wisdom, New Goch, G. M., Ltd., P. O. Box 540, Johannesburg.

MINING DINNER AT JOHANNESBURG.

THE old students of the Royal School of Mines resident in South Africa held their annual dinner at the Rand Club, Johannesburg, on Saturday, October 7th.

Mr. J. Harry Johns (consulting engineer to Messrs. Barnato Bros.), presided. He was supported by Mr. R. A. Sawyer (past president of the Geological Society of South Africa), and Mr. H. H. Webb (consulting engineer to the Consolidated Goldfields of South Africa).

The attendance also included Messrs. C. B. Brodigan, M. de Chazal, E. H. Clifford, A. M. M. Cooke, F. H. P. Creswell, E. H. Douglas, H. M. Eddowes, S. E. Fletcher, S. H. Ford, S. F. Franco, L. C. Franck, H. D. Griffiths, E. W. Hammond, E. Hay, C. B. Horwood, D. L. James, A. J. Jones, J. Harry Johns, R. Laroque, A. N. Mackay, H. F. Marriott, W. P. O. MacQueen, H. Meyer, J. Morris, H. G. Nitch, E. Pam, M. Park, A. E. Payne, R. Pill, H. Power, R. D. Robinson, Reg. W. Robinson, H. F. Roche, A. P. Rouillard, C. B. Saner, A. R. Sawyer, Ronald Sawyer, P. Scholer, J. Sewell, R. B. Smith, Prof. G. H. Stanley, U. P. Swinburne, H. H. Webb, R. B. Webber, and Prof. J. Yates.

The loyal toast was followed by that of "The Royal School of Mines," given by the chairman. After remarking that it was nearly a quarter of a century since he left the college, Mr. Johns emphasised the importance of teaching students to put scientific knowledge to practical use; laid stress upon the importance of training in mechanical engineering and electricity, and congratulated the Government upon choosing a thoroughly practical engineer to fill the Chair of Mining at the Royal School of Mines, remarking that since the days of Sir Henry de la Bèche the school had always been renowned for its brilliant teaching staff, and that Mr. S. H. Cox was a worthy successor to the late Sir Clement le Neve Foster.

Mr. Brodigan replied, heartily supporting the chairman's remarks. He endorsed the general opinion that, considering the national importance of the mining industry to Great Britain, the Government should endow more liberally the leading mining school of the world.

Mr. H. H. Webb, who proposed "The Mining Industry," compared the Transvaal with the States of California and Nevada, the former of which would in the speaker's opinion, have become an agricultural country, independently of its mineral resources. On the other hand, in Nevada, a less fertile State,

agricultural progress had started and advanced *pari passu* with the development of the country's mineral resources, owing to the economic assistance afforded by the latter.

The speaker, remarking that the Transvaal probably resembled the last-mentioned State, brought forward a number of statistics which clearly showed how much the Colony was indebted to the mining industry.

In the absence of Mr. H. Weldon (acting commissioner of mines), Mr. C. B. Saner responded, alluding to the rapid and continuous advance of the mining industry in a period of universal depression.

Mr. U. P. Swinburne then proposed "The Land We Live In," remarking that the subject of his toast would provide education, experience, and a living for many School of Mines men.

Mr. F. H. P. Creswell, in reply, said a previous speaker compared the Transvaal to California and Nevada; he (Mr. Creswell) took a more hopeful view. He remarked incidentally that he had adopted the Transvaal as the country in which he intended to live and die. The speaker opined that School of Mines men could solve all difficulties connected with their profession; and, in all affairs their attitude should be that of good citizens.

In the course of the evening two interesting announcements were made. A letter was read from the Commissioner of Mines (Mr. H. Weldon) offering a scholarship of £32 to be competed for by the mining students of the Transvaal Technical Institute. Mr. Webb brought forward a proposal originating from Mr. H. G. Nitch, to the effect that a register should be kept of all old School of Mines students residing in the country.

Mr. Webb stated that the Consolidated Goldfields of South Africa would always be ready to provide work for a certain number of students who had finished the graduation course at the Royal School of Mines. The students would earn sufficient at such work to maintain them while they were gaining practical experience. Those present heartily concurred in the scheme, and Mr. C. B. Horwood (hon. secretary to the Dinner Committee), kindly consented to keep the register.

In connection with the above, those who have studied at the Royal School of Mines are requested, should they come to South Africa, to send their names (with a statement of qualifications and experience) to Mr. C. B. Horwood, Rand Club, Johannesburg.

NOTABLE DOCK ENGINEERING.

BY J. RENEY SMITH, M.I.MECH.E., M.I.N.A.

IT seems to be accepted that the modern port should anticipate vessels up to 1,000 ft. in length, 100 ft. in breadth, and 30 ft. draught of water. This draught forms the great demand of the shipbuilder from port authorities, as the length and breadth of vessels have been extended far beyond the proportions in which the draft of ships has been increased. It has been stated that a large trans-Atlantic line of 23,000 tons displacement can carry only 600 tons of cargo—if the draught were increased by 1 ft. 1,500 tons could be carried, and 2 ft. increase would mean a carrying capacity of 2,400 tons, with a very trifling loss of speed. The departure draught, therefore, is of vital importance for the commercial success of the modern vessel. The engineers engaged in the construction of dock works are constantly feeling this development of the steamship, the increase in capacity and power rendering obsolete the accommodation in the ports which not long ago seemed adequate, and to all human foresight, anticipated shipbuilding developments for a considerable time. The complaint of the shipbuilder is, that his efforts to meet the demands of the shipowners for larger and speedier vessels are not seconded by those responsible for dock and harbour accommodation, and shipowners will certainly divert their business to those ports where, all else being equal, an up-to-date policy is adopted. A brief survey of the advance of rival ports will illustrate the keen competition in regard to dock accommodation.

THE LONDON DOCKS.

The Thames, which in the past has been served by the London and Indian Docks, the Tilbury Dock Company, the Milwall Docks on the north side, and the Surrey Commercial Docks on the south side of the river, now feels the necessity for advancing with the times, and the London County Council and Thames Conservancy have at last raised the whole question of harbour accommodation at our principal port, and have applied for powers to modernise the docks. A Royal Commission reported, and a Port of London Bill was obtained, providing for a navigable channel up to the Royal Albert Docks, having a depth of 30 ft. at low water of ordinary spring tides. These

authorities also intend applying to Parliament for powers to take over the existing docks, and place them under one authority. Great improvements are anticipated to insure the speedy handling and dispatch of the largest cargoes, and there is little doubt that when the various dock companies are combined under one authority, the advance in accommodation will be rapid.

PROVINCIAL DOCKS COMPARED.

At Southampton there has been a great movement for the development of the dock system, to compete with the northern port of Liverpool; powers have been obtained for deepening their entrance channel to 35 ft. at low water of ordinary spring tides, which is increased by 13 ft. at high water, a depth almost constant for nearly four hours, owing to the unusual natural advantage of double tides at this port. Graving docks have been constructed to receive vessels 750 ft. to 850 ft. in length, and 35 ft. to 88 ft. in breadth, the depths on the blocks being 33 ft. at high water of ordinary spring tides,

At Avonmouth, new docks are under construction having entrances 100 ft. in width, locks 850 ft. long, and a depth of water of 36 ft. at high water of ordinary, neap tides, and 46 ft. at high water of ordinary spring tides. Adequate graving dock accommodation is also contemplated for dealing with the repairs of the largest vessels. Ships of almost any size will then enter these docks, on any tide throughout the year. For dispatch in discharging cargoes at low rates these docks will claim to have no equal in the country.

At Glasgow the gigantic works of narrowing the channel and deepening the river Clyde has been the chief source of the great prosperity of the northern port, so that within the memory of persons still living, a stream over which one could at one time wade has now become a channel capable of allowing vessels drawing 24 ft. of water to ride at anchor. The quayage of the harbour and docks amounts to over 15,000 lineal yards, with an area of water space of 205 acres.

The Tyne is admirably situated as regards accommodation, the conditions of the river not having as yet imposed any limitations to the size of the vessels using the port; while the competition of shipbuilders

and others has secured to the district no less than 23 graving docks, ranging from 300 ft. to 438 ft. in length. There is a depth of 25 ft. at the bar at low water of ordinary spring tides, the rise at neap tides being 11 ft.

ANTWERP HAMBURG.

These rivalries are not, however, by any means confined to the United Kingdom. At the port of Antwerp, strenuous exertions are being made to cater for the largest class of vessel, and those drawing 28 to 30 ft. of water can now moor safely alongside the new quays. Hamburg is making rapid strides. The new harbour works just completed have cost over £6,000,000 sterling, and extensive dredging is in progress to deepen the bar at Blankenau, which at present limits the draught of vessels to 23 ft. at mean spring tides. Dry docks of ample size are provided, also a floating dock of large dimensions, while no less than 540 cranes of all sizes are provided, the lightest dues being charged.

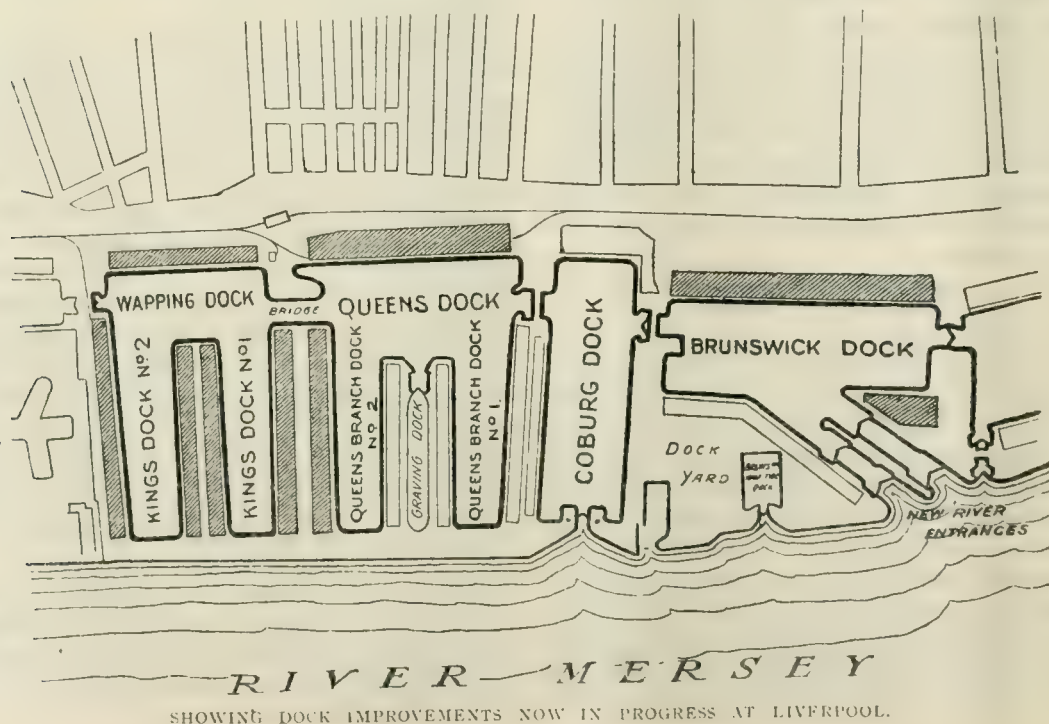
NEW YORK.

It is the German boast that when these works are completed, Hamburg will be the greatest and cheapest harbour on the continent. The rapid development in the size and depth of vessels has chiefly been in those engaged in trans-Atlantic trade, and the consequence is that the American ports are also feeling

the necessity for improvement. New York, the main port of arrival and departure, with a fine land-locked harbour, has an important scheme for deepening the approach channel to 40 ft., with a minimum of 35 ft. at quays and wharves, at all states of the tide.

LIVERPOOL DEVELOPMENTS.

It is gratifying that with all these rivalries Liverpool intends to maintain the high position she has won. The great work of improvement in the Liverpool dock system is quietly and systematically carried on. The approach channels have been deepened, until practically all the vessels using the docks can leave or enter the river at any state of tide. The northern section of the Liverpool Docks is still being developed, and preliminary works for contemplated new docks have been carried out. The new graving dock, 804 ft. long, will shortly be completed. A new half-tide dock on the site of the old Sandon basin and Wellington half-tide dock, has been constructed, with deep water entrances from the river. The old Sandon dock has been deepened, and a 90-ft. entrance made, leading from the new half-tide dock. The Canada graving dock has been constructed, 925 ft. long, with a width of entrance of 94 ft., capable of accommodating the largest vessels for some time to come. Further south, the construction of King's docks, Nos. 1 and 2, is being pushed rapidly forward, and the Wapping dock



deepened to 10 ft. 6 in. below the old dock sill, the same depth as the King's docks opening out of it. The Queen's dock is also being deepened to the same extent, and the new Queen's graving dock is practically completed. This dock is 634 ft. in length, 80 ft. in breadth, and forms a valuable addition to this section of the dock estate. The greater portion of the Brunswick dock has been deepened to 21 ft. below the old dock sill, and preparations are being made for the extension of the dock in a southerly direction.

Dredging operations are being pushed on to deepen the approaches, and the river entrances. Quite recently a new graving dock, No. 4 Herculeum, has been opened, 754 ft. long and 80 ft. wide. On the Birkenhead side of the river, improvements to the existing docks are being carried out, and the graving docks, basins, etc., of the Tranmere Bay Development Company are well advanced towards completion, while the two graving docks, respectively 900 ft. and 750 ft. long, are also in an advanced stage.

PROPOSED CHAIR OF NAVAL ARCHITECTURE AT LIVERPOOL.

Sir William White suggested a year or two ago, that Liverpool should endeavour to found a Chair of Naval Architecture at the Liverpool University, and, acting on this suggestion, a sub-committee was appointed to discuss ways and means of enlisting sympathy and active support of local shipowners. So far the matter has advanced slowly, but the active co-operation of those interested would help along a movement of such great importance. A Chair of Naval Architecture in Liverpool would at once give a fillip to the study of that science upon which so much depends. It would assist those who, by diligent research, will in the future advance the progress of ship design on the lines of economy, the only possible lines, if we are to compete successfully in the keen competition for the world's commerce.

Abstract of presidential address to Liverpool Engineering Society.

OPENINGS FOR TRADE ABROAD.

Portugal.

A decree has been published sanctioning the expenditure by the Administration of the State Railways of about £52,176 on the construction of the Valença Monção section of the railway from Valença to Melgão.

Italy.

Tenders, which will be received up to the 17th inst. by the "Ministero dei Lavori Pubblici, ufficio d'ispezioni," are invited for the supply of all works and instruments necessary for the drainage of the marshes of Port Columena, in the territory of Nardo and Avetrana, to a total value of £10,024.

Russia.

The British Commercial Agent in Russia reports that the Ministry of Ways will undertake in the spring the construction of a new railway from Ufa to the rich copper and iron deposits of the region known as Magnitnaia Gora (Magnet Hill). The length of the new line will be 144 versts (76 miles). It is also stated that proposals have been under consideration for the construction of a line for the conveyance of coal from

the station of Nikitovka, on the Kursk-Kharkoff-Sevastopol Railway, in a straight line to St. Petersburg.

Belgium.

Tenders are invited for the construction of a section of railway from Neupont to Gembes, part of an extension to Graide of the Rochefort-Wellin line. The estimated value of the work is £11,822. Tenders accompanied by a deposit of £1,160, must be sent by December 5th, addressed to "Monsieur le Directeur Général, La Société Nationale des Chemins de Fer Vicinaux," 14, Rue de la Science, Brussels.

The Commercial Intelligence Branch of the Board of Trade have been notified by H.M. Consul-General at Antwerp that the municipal authorities of that city are calling for tenders for the erection of a metal shed, an extension of the existing shed, on the Quai du Rhin, and for alteration of the sheds on the Quai Cockerill and the Quai de la Station. The cost of the work is estimated at £2,122, and a deposit of £200 is required to qualify any tender. The specification relating to the proposed works may be obtained from the Hotel de Ville, Antwerp. Tenders should reach the Burgo-master by the 16th inst.

TECHNICAL SOCIETY NOTES.

SIR ALFRED HICKMAN has been addressing the Wolverhampton and District Engineering Society upon the necessity for the adoption of up-to-date methods in the factory and the utility of scientific instruction to those engaged in engineering. Commenting upon the change in motive power which had taken place in connection with manufacture in the Midlands, he asserted that the supremacy of steam had not only been challenged, but superseded. For his own part, he had put on the scrap heap twenty-four steam engines, and instead, utilised electric motors supplied from a generating plant with gas engines as prime movers. The consequent saving in fuel alone amounted to £7,500 a year. He believed that soon all steam engines would be done away with or kept on one side for emergencies. The principle at the bottom of this change was, he believed, the correct one, and it gave a higher thermal efficiency. This seemed to be revolutionising the whole system of motive power in the country.

Professor Burstall chose for the subject of his presidential address to the Birmingham University Engineering Society the "Possibilities of the heat engine." He pointed out that owing to the advanced stage which the science of thermodynamics has reached, we could easily predict the lines on which the heat engine of the future will be developed. He considers that the steam engine has reached its maximum efficiency, and that much more development in this form of engine cannot be expected, owing to its great loss of economy. He looks in the future for the utilisation of the sun's heat direct for heat engines. Discussing the prospects of the gas engine. Professor Burstall said that the future ideal production

would be an engine with a very high compression, thorough scavenging action, and of the four-stroke cycle. He considered that the outlook for the success of gas turbines was remote, the practical difficulties in their way being so great.

The paper read before the Sheffield meeting of the Iron and Steel Institute on "Vanadium Steel for Motor-car Manufacture," has produced a fruitful discussion in the press. The correspondence in the Birmingham Daily Post is, on the whole, confirmatory of the conclusions arrived at by Dr. Guillet. Mr. T. Vaughan Hughes, who claims to have made many mechanical and other tests on various grades of vanadium steel is certainly in agreement with the author of the paper. Mr. J. Kent Smith, joint author with Capt. Riall Sankey of a paper read last session before the Institution of Mechanical Engineers, joins issue on some points with Mr. Vaughan Hughes.

He plainly states that it has never been contended that any vanadium steel is an unbreakable material; the discovery of this latter is a goal that the most sanguine cannot hope to reach. The remarkable immunity, however, of such types of vanadium steel as are used in motor-car construction during severe practical trials upon very many tons of material in most diverse forms lasting over several years, is worthy of note. It is noteworthy that on the "Arnold test" annealed vanadium chrome steels have given the highest "reversal" figures yet obtained. Several railway companies are now using vanadium steel, one in very considerable quantities. The paper therefore dealt not only with possibilities, but with actualities.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

Last Day.

CONTRACTS OPEN.

Manchester. Supply of (a) tramcar trucks ; (b) electrical equipments for cars, for the tramways committee. Mr. J. M. McElroy, General Manager, Tramways Department, 55, Piccadilly, Manchester...

Last Day

Nov. 11

Coventry.—Supply and erection at their Foleshill works of six purifiers, each 30 ft. wide by 6 ft. deep, four of the purifiers to be 50 ft. long and two to be 60 ft. long each, with 24-in. diameter valves and connections, for the Gas Committee. Mr. Fletcher W. Stevenson, engineer and general manager, Gasworks, Coventry ...

Nov. 13

Barrow-in-Furness.—Supply and erection of (Section A) one 500-k.w. combined steam engine and generator ; (B) one balancer booster ; (C) switchboard panels and connections for generator and booster ; (D) one water-tube boiler with superheater ; (E) one mechanical stoker ; (F) steam and exhaust pipes, valves, etc. ; (G) one economiser ; (H) ironwork ; (I) one 15-ton travelling crane ; (J) one cooling tower—for the Corporation. Mr. H. R. Burnett, Electricity Works, Barrow-in-Furness ...

Nov. 13

Matlock Bath.—The following works in connection with Upper Wood high-level water supply, for the Urban District Council of Matlock Bath and Scarthin Nick : (1) excavating for and laying and jointing cast-iron pipe mains ; (2) construction of building and well for pumping station ; (3) construction of concrete reservoirs. Mr. William Jeffrey, C.E., Matlock Bath : ...

Nov. 14

Barnsley.—Providing and fixing of Lancashire steam boiler, 24 ft. long by 7 ft. diameter, and for the purchase of the existing steam boiler now in use at their public baths, Park Street, Barnsley. Mr. J. Henry Taylor, M.Inst.C.E., borough surveyor, Manor House Offices, Barnsley ...

Nov. 14

Waltham Abbey.—Stream covering, building of retaining wall, erection of wrought-iron fencing, etc., round their new public offices, Waltham Abbey, for the Waltham Holy Cross Urban District Council. Mr. W. Turner Streather, engineer and surveyor, Town Hall, Waltham Abbey, Essex ...

Nov. 15

Ashford, Kent.—Supply of cast-iron water-pipes from 9 in. to 2 in. in diameter (about 270 tons), and special castings and sluice valves, for the Urban District Council. Mr. Wm. Terrill, surveyor, 5, North Street, Ashford, Kent ...

Nov. 16

London. The work and materials required in the construction of a new bridge over the Grand Junction Canal at Old Oak Lane, (near Willesden Junction) for the Light Railways and Tramways Committee of the Middlesex County Council. The contract will include the demolition of the old bridge and erection of a new span bridge in brick, stone, granite, and steel, preparatory to the laying of a new light railway. Mr. H. T. Wakelam, M.Inst.C.E., county engineer, Middlesex Guildhall, Westminster, S.W. ...

Nov. 16

Belfast.—Supply, delivery, and erection of motor pumps and accessories, overhead travelling crane, etc., in connection with Greencastle district drainage, for the Improvement Committee. City Surveyor's Office, Belfast ...

Nov. 20

Bray (Ireland).—Supply and delivery of the following for the Electricity Department : (1) 220 yds $\frac{7}{8}$ concentric paper-insulated and lead-covered cable for a working pressure of 200 volts ; (2) ten 10-ampere alternating current induction voltmeters 100 volts, 60 periods. Mr. P. MacDonnell, Town Hall, Bray ...

Nov. 21

London, N.—Supply, delivery and fixing of underground pumping machinery to raise 9,200 gallons of sewage per hour through a 6 in. rising main to an approximate height of 61 ft., the machinery to have automatic starting and stopping gear, for the Finchley Urban District Council. The motor is to be wound for a speed of 600 r.p.m., the voltage of continuous supply being 500 volts. The rising main and underground chamber will be provided by the Council. The Engineer, Council Offices, Finchley, N. ...

Nov. 24

Fleetwood (Lancs.).—Construction of a new hulking adjoining the ferry landing at Knot End, near Fleetwood, for the Fleetwood Urban District Council. Mr. Edward Frobisher, Town Hall, Fleetwood ...

Nov. 26

COMING CONTRACTS.

Rawtenstall.—The Council have received sanction to a loan of £12,000 for electricity supply.

London County Council.—Loans for electric lighting purposes have been recommended for Battersea £9,792, Fulham £25,000, Hampstead £6,000, St. Marylebone £90,405, and Stepney £10,000.

Bath.—The Local Government Board have consented to the borrowing by the corporation of £18,120 for purposes of electric lighting.

Torquay.—An inquiry has been held by the Local Government Board in regard to an application of the corporation for sanction to borrow £9,500 for purpose of electric lighting and power supply.

Oldham.—A Local Government inquiry has been held into the application of the corporation for sanction to borrow £48,114 for purposes of electricity undertaking.

Willesden.—An inquiry has been held into the application for sanction to borrow £20,000 for electricity purposes.

Pontardawe.—A Local Government Board inquiry has been held into an application of the Pontardawe Rural District Council for sanction to borrow £4,500 for waterworks purposes in Llanguicke.

Farnworth.—The Kearsley Spinning Company are building a large mill at Crestclee, near Farnworth, Bolton, which is to be fitted for electrical driving.

Newport.—It is stated that the Newport and Alexandra Docks and Railways Company propose to carry out in the near future large dock extensions.

CONTRACTS CLOSED.

Johnstone, N.B.—Messrs. Pollock, White and Waddell, of Johnstone, N.B., have contracted to supply five gas engines and suction gas producers, with four sets of pumps for sewage pumping, to the Fleetwood Urban District Council. They have also received a contract from the Pembroke Dock Council for two suction gas plants for the main water pumping station.

Rugby.—Messrs. Willans and Robinson, Limited, of Rugby, have recently received the following orders: Four turbines of 1000 kw. each, for the new station of the Cleveland and Durham Power Company at Middlesbrough; three turbines of 1000 kw. each for Messrs. Bruce Peebles' Durham scheme for supplying power to collieries; and two of 1000 kw. each, for their Fife scheme.

London.—Messrs. J. E. Hopkinson and Co., Limited, have just received from Messrs. Ed. Surcouf and Co. of Billancourt, France, intimation of their decision to adopt the Hopkinson patented solid tyre for the Renard automobile trains.

Alloa.—Messrs. Mackay Brothers, Alloa, have received an order from London owners for a steamer to carry 2,200 tons deadweight.

Wellington (New Zealand).—The Council has accepted the tender of the Electrical Construction Company for the supply of power-house apparatus to the extent of £9,400; Messrs. Rouse and Hurrell, Messrs. J. Duthie and Company, and Hadfield's Steel Foundry Company have also received orders in connection with the tramway construction work.

Tipton.—Messrs. Joseph Wright, of Tipton, have in hand calorifiers for the Leeds Infirmary and Dudley and Burnley Unions. Berryman patent heaters for Chili and Brazil, and four special live steam heaters for Chatham and Portsmouth Dockyards.

Middlesex.—The County Council has accepted the tender of Messrs. Wimpey and Company (£35,884) for the construction of the Bounds Green Road, Wood Green, and Southgate tramway.

Buenos Ayres.—The Brush Electrical Engineering Company have received the following contracts:—Buenos Ayres and Pacific Railway Company—three 250-k.w. turbo-alternators with condensers and pipe-work. Spinning Mill, Oporto—400 b.h.p. turbo-alternator, 43 motors and accessories for complete electric lighting and power installation.

APPOINTMENTS VACANT.

Bolton.—The Bolton Corporation invite applications for the appointment of an assistant engineer in connection with extensions of their waterworks undertaking. Commencing salary £250 per annum. Mr. Samuel Parker, town clerk, Town Hall, Bolton ... Nov. 12

Gloucester.—The Corporation invite applications for the appointment of general manager of electric light railways within and near the city of Gloucester. Mr. Geo. Sheffield Blakeway, town clerk, Guildhall, Gloucester ... Nov. 13

India Office.—For the service of the Government of India, an assistant for the carriage and wagon department of the North-Western Railway of India. Salary to commence at Rs.450 per month, rising by increments of Rs.50 per month yearly to a maximum of Rs.600 per month. Director - General of Stores, India Office, Whitehall, S.W. ... Nov. 13

India.—The Bombay, Baroda, and Central India Railway Co. invite applications for appointment as a chief draughtsman in the carriage and wagon department of the company's service. Salary, Rs. 400 per calendar month. Mr. T. W. Wood, Secretary, Gloucester House, Bishopsgate Street Without, London, E.C. ... Nov. 15

Leeds.—The Council of the University of Leeds require an assistant lecturer and demonstrator in electrical engineering. Salary £175. Particulars from the Registrar. ... Nov. 18

APPOINTMENTS FILLED.

Battersea.—The Governing body of Battersea (London) Polytechnic have appointed Mr. E. G. Tottle, M.I.M.E., to the post of superintendent of the drawing office and workshops in the department of mechanical engineering.

West Ham.—Mr. J. W. Seabrook, A.M.I.E.E., A.M.I.M.E., of Barking, has been appointed borough electrical engineer of West Ham.

Islington.—Mr. T. C. Margary, senior mains engineer at Islington, having completed satisfactorily six months on probation superintending the mains work, has been permanently appointed to the latter position at a salary of £200.

Maidstone.—Mr. G. E. Wintle has resigned his position at the Ipswich Corporation Electricity Works, having been appointed Station Superintendent for the Maidstone Corporation Electricity Supply and Tramways Station.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows:—

Consols: Dec 1st. General Settlements: Nov. 15th, 30th. Dec. 14th, 29th. Bank Rate, September 28th, 1905, 4 per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

ENGINEERING, IRON, AND STEEL COMPANIES.—Contd.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid p.	Closing Prices	Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices
11,370	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	8	2 1/2 - 3	750,000	1	7 1/2	Howard & Bullough, Ltd., Ord.	1	1 1/2 - 1 1/4
10,000	5	3/-	Do. Cum. Pref. 6 per cent.	5	4 1/2 - 5 1/4	25,000	10	6/-	Do. 6% Pref. (Non-Cum.)	10	12 1/2 - 13 1/4
3,210,000	1	1/-	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 1/2 - 3 1/4	37,500	10	20	Kynoch, Ltd.	100	98 - 101
76,970	5	2/-	Do. 4% Cum. Pref.	5	5 - 5 1/4	49,587	10	5%	Do. Cum. Pref. 5%	10	103 1/2 - 11 1/4
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	103 - 105	300,000	1	4 1/2	Lambert Bros., Ltd., Ord.	1	8 1/2 - 8 1/4
£100,000	100	4 1/2	Aveling and Porter, Ltd., 4 1/2% Reg. Mt. Dbs. Rd.	100	96 - 99	50,000	5	2/9	Do. 5 1/2% Cum. Pref.	5	4 1/2 - 4 1/4
580,000	1	1 1/2	Babcock and Wilcox, Ltd., Ord.	1	8 1/2 - 8 1/4	40,000	3	2 1/4	Leeds Forge Co., 7% Cum. Pref.	3	4 1/2 - 4 1/4
100,000	1	7 1/2	Do. 6% Cum. Pref.	1	1 1/2 - 1 1/4	200,000	1	7 1/2	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 1/2 - 1 1/4
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 - 5 1/4	£200,000	Stk	4 1/2	Do. 4 1/2% 1st Mt. Deb. Stk., Red.	100	108 - 110
250,000	1	6 1/2	Baldwins, Ltd., 5 1/2% Cum. Pref.	1	1 1/2 - 1 1/4	40,000	10	5/-	Mather & Platt, Ltd., 5% Cum. Pref.	10	11 1/2 - 11 1/4
£250,000	Stk	4 1/2	Do. 1st Mt. 4 1/2% Deb. Stk. Red.	100	102 - 104	210,000	1	8 1/2	Measures Bros., Ltd., Ord.	1	1 1/2 - 1 1/4
150,000	4 1/2	2 1/2	Barrow Hematite Steel Co., Ltd., O.	4 1/2	18 - 14	75,000	1	6 1/2	Do. 5 1/2% Cum. Pref.	1	1 1/2 - 1 1/4
50,000	4 1/2	3/-	Do. do. Cum 2nd. Pref.	4 1/2	5 - 5 1/4	£250,000	Stk	4 1/2	Do. 4 1/2% 1st Mt. Db. Stk., Red.	100	98 - 101
83,384	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4 1/2 - 5 1/4	21,943	5	2/6	Muntz Metal, Ltd.	5	4 1/2 - 5
£500,000	100	4 1/2	Beardmore (Wm.) & Co., Ltd., 4 1/2% 1st Mt. Dbs., Red. Scrip 50% pd	—	104 - 106	14,248	5	5%	Do. Pref. 5%	5	4 1/2 - 5 1/4
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	12 1/2 - 13	5,000	62 1/2	47/6	Nantyglo and Blairston Iron Works, Ltd., 8% Cum. Pref.	62 1/2	80 - 83
£366,600	Stk	4%	Do. 4% Deb. Stock, Red.	100	100 - 102	50,000	5	3/-	North-Eastern Steel Co., Ltd., 4 1/2% 1st Mt. Db. Stk., Red.	100	128 - 12 1/2
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	3 1/2 - 4	70,000	10	10/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "A"	5	5 - 5 1/4
300,000	1	6 1/2	Do. 5 1/2% Cum. Pref.	1	3 1/2 - 4	£400,000	Stk	4%	Do. 6% Cum. Pref. "B"	5	6 - 6 1/4
£300,000	Stk	4 1/2	Do. 4 1/2% Red. Deb. Stock	100	93 - 96	20,000	5	3/-	Pease & Partners, Ltd., Ord.	10	13 1/2 - 13 1/4
1,629,760	1	6 1/2	Bolckow, Vaughan and Co., Ltd., O. Nos. 1,629,760	1	1 1/2 - 1 1/4	65,000	1	—	Do. 4% Perp. Deb. Stock	100	93 - 102
1,860,900	1	3 1/2	Do. Nos. 1,639,101-2,500,000	12 1/2	1 1/2 - 1 1/4	13,000	5	—	Peebles (Bruce) & Co., Ltd., 6% C.M.P.	5	4 1/2 - 5 1/4
1,160,000	1	10 1/2	Brown (John) and Co., Lim., Ord.	15/-	1 1/2 - 1 1/4	230,000	1	—	Pooley (Henry) & Son, Ltd., Ord.	1	11 1/2 - 11 1/4
590,000	1	1 1/2	Do. Ord., Nos. 1,160,001-1,750,000	1	1 1/2 - 2 1/4	126,938	5	2/-	Do. 5 1/2% Cum. Pref.	5	4 1/2 - 4 1/4
74,000	10	5 -	Do. 5% Cum. Pref.	10	11 1/2 - 11 1/4	73,062	5	2/-	Projectile Co. (1902), Ltd., Ord.	1	4 1/2 - 4 1/4
154,500	5	2 1/2	Cammell, Laird & Co., Ltd., Ord.	5	9 1/2 - 10 1/4	£230,000	—	5%	Rhymney Iron Co., Ltd.	5	1 1/2 - 2 1/4
232,500	5	2/6	Do. 5% Cum. Pref.	5	5 1/2 - 5 1/4	350,000	1	7 1/2	Do. 5% Mort. Deb. Red.	100	102 - 104
450,000	1	1 1/2	Clayton & Shuttleworth, Ltd., Ord.	1	1 1/2 - 1 1/4	£300,000	Stk	4 1/2	Richardsons, Westgarth & Co., Ltd., Ord. 350,001-700,000	1	1 1/2 - 1 1/4
70,000	5	2/6	Do. 5% Cum. Pref.	5	5 1/2 - 5 1/4	£350,000	Stk	4 1/2	Do. 6% Cum. Pref.	100	97 - 100
£250,000	Stk	4%	Do. 4% 1st Mort. Db. Stk. Red	100	100 - 102	35,000	10	12/-	Do. 4 1/2% Perp. Deb. Stock	100	97 - 100
100,000	10	30/-	Conssett Iron Co., Ltd., Ord.	7 1/2	37 - 38	275,000	1	6d.	Ruston, Proctor & Co., Ltd., Ord.	1	10 1/2 - 10 1/4
57,031	10	10/-	Crossley Bros. Ltd., Ord. 40390/97370	10	15 1/2 - 15 1/4	300,000	1	7 1/2	Scott (Walter) Ltd., Ord.	1	18 1/2 - 18 1/4
40,389	10	5%	Do. 5% Cum. Pref.	10	11 1/2 - 11 1/4	£300,000	Stk	4 1/2	Do. 6% Cum. Pref.	1	18 1/2 - 18 1/4
75,000	1	2/6	Delta Metal, Ltd. Shares	1	2 1/2 - 2 1/4	£115,300	100	5%	Do. 4% Perp. Deb. Stk.	100	94 - 97
1,259,594	1	3 1/2	Dorman, Long & Co., Ltd.	1	1 1/2 - 1 1/4	£97,900	100	6%	Shelton Iron, Steel and Coal Co., Ltd.	100	94 - 97
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	92 - 96	250,000	1	1/-	1st Charge 5% Dbs., Red.	100	97 - 101
200,000	5	3/-	Dunderland Iron Co., Ltd., 6% Cum. Pref. and Participating	5	4 - 4 1/4	£300,000	Stk	4 1/2	Do. 6% 2nd Mort. Dbs., Red.	100	97 - 101
250,000	1	9 1/2	Dunlop (James) & Co., Ltd., Ord.	1	4 1/2 - 4 1/4	25,000	10	5/6	South Durham Steel & Iron, Ltd., Ord.	1	1 1/2 - 1 1/4
800,000	1	7 1/2	Do. 6% Cum. Pref.	1	4 1/2 - 4 1/4	300,000	1	1 1/2	Do. 6% Cum. Pref.	1	1 1/2 - 1 1/4
4,721	13	18/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	10 1/2 - 11 1/4	£300,000	Stk	4 1/2	Do. 4 1/2% Perp. Deb. Stock	100	93 - 96
69,754	13	10/-	Do. do. do.	10	8 1/2 - 9 1/4	25,000	10	—	Stephenson (Robert) & Co., Ltd., Ord.	10	24 - 3
20,250	10	8/-	Elliott's Metal, Ltd.	8	5 - 5 1/4	85,000	10	9/-	Do. 5 1/2% Cum. Pref.	10	5 - 5 1/4
5,000	10	5%	Do. Cum. Pref. 5%	10	8 1/2 - 9 1/4	£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	80 - 83
186,748	Stk	4%	Do. Deb. 4%	100	90 - 94	55,000	10	6d.	Stewarts & Lloyds, Ltd., Ord.	10	19 1/2 - 19 1/4
25,000	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref.	10	11 1/2 - 12 1/4	694,732	1	6d.	Do. 6% Cum. Pref.	10	14 1/2 - 15
£250,000	Stk	4 1/2	Do. 4 1/2% Mort. Deb. Stk. Red.	100	100 - 103	538,845	1	6d.	Richardson, Lim. Ord.	1	1 1/2 - 1 1/4
126,000	3	3/-	Fraser & Chalmers, Ltd., Ord.	3	3 1/2 - 4 1/4	£240,000	Stk	4 1/2	Do. 5% Cum. Pref.	1	1 1/2 - 1 1/4
21,000	3	1 1/2	Do. 7 1/2% Cum. Pref.	3	5 1/2 - 5 1/4	300,000	1	6d.	Do. 4 1/2% 1st Mort. Deb. Stk. Red	100	96 - 99
10,000	10	5%	Galloways, Ltd., 5% Cum. Pref.	10	7 1/2 - 8	£200,000	Stk	4 1/2	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	1 1/2 - 1 1/4
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Red.	100	88 1/2 - 89 1/4	£115,500	1	7 1/2	Do. 4% Irredeem. 1st Mort. Deb.	100	81 - 83 1/2
16,800	10	10/-	Greenwood & Batley, Ltd., Ord.	10	6 1/2 - 7	£162,680	1	7 1/2	Thornycroft (John L.) & Co., Ltd., Ord.	1	2 - 1
9,600	10	7%	Do. 7% Cum. Pref.	10	10 1/2 - 11	10,000	10	5/-	Do. do. 6% Cum. Pref.	1	1 1/2 - 1 1/4
965,000	1	1 1/2	Guest, Keen & Nettlefolds, Ltd., Ord.	1	2 1/2 - 2 1/4	£508,195,200	£100	£3	Taylor (J.) & Sons, Ltd., 5% Cum. Pf.	100	94 - 93 1/2
344,000	5	2/6	Do. 5% Cum. Pref.	5	6 1/2 - 6 1/4	£360,114,100	£100	£1 1/2	United States Steel Corp. Com. Stk.	£100	83 1/2 - 84 1/2
£1,850,500	Stk	4%	Do. 4% Irred. Mort. Deb. Stk.	100	106 - 108	£162,680	£1000	5%	Do. 10-60yr. 5% Skg. Fd.G. Bds.	£1000	99 - 101
13,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref.	5	2 1/2 - 3 1/4	750,000	1	1/-	Vickers, Sons & Maxim, Ltd., Ord.	1	22 - 23
250,000	1	1 1/2	Hadfield's Steel F'dry Co., Ltd., Ord.	1	3 1/2 - 4	£275,000	Stk	5%	Do. 5% Non-Cum. Pref.	100	120 - 125
20,000	10	4/6	Do. 4 1/2% Cum. Pref.	10	10 1/2 - 11	£1,250,000	Stk	4%	Do. 5% Non-Cum. Pref. Stock	100	105 - 107
30,000	5	3/-	Hall (J. & E.), Ltd., 6% Cum. Pref.	5	5 - 5 1/4	£1,000,000	1	1 1/2	Do. 4 1/2% 2nd Mort. Dbs., Red.	100	105 1/2 - 107 1/2
408,505	1	1 1/2	Harvey United Steel Co., Ltd.	1	4 1/2 - 4 1/4	225,000	1	1 1/2	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	1 1/2 - 1 1/4
47,500	10	7 1/2	Hawthorn, Leslie & Co., Ltd., Ord.	10	98 - 100	500,000	1	7 1/2	Do. 6% Cum. Pref. Ord.	1	1 1/2 - 1 1/4
28,001	5	7/-	Head, Wrightson & Co., Ltd.	5	5 1/2 - 6	£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	90 - 93 1/2
85,000	1	7 1/2	Hill (Richard) & Co. (1899) Ltd., Ord.	1	4 - 1	7,697	5	2/9	Do. Mort. Deb. 4 1/2%	5	4 1/2 - 4 1/4
18,000	5	3/-	Do. 6% Cum. Pref.	5	5 1/2 - 5 1/4	300	Stk	4 1/2	Willans & Robinson, Ord.	5	1 1/2 - 2
£100,000	Stk	6%	Hornsby (Richard) & Sons, Ltd., Ord.	100	101 - 103	66,666	5	3/-	Do. 6% Cum. Pref.	5	2 1/2 - 3 1/4
			Do. 6% Cum. Pref.	100	101 - 103	£216,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	77 - 82
						£150,000	Stk	4 1/2	Yorkshire Iron & Coal Co., Ltd., 4 1/2% 1st Mort. Deb. Stk. Red.	100	77 - 79

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

ELECTRIC TRACTION.—Contd.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices.	Present Amount Subscribed.	Shares	Last Dividend.	Name	Paid up.	Closing Prices
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	8-7	£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	98-100
125,000	1	7d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	8-7	£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	101-105
120,000	1	1/2s	Bell's Asbestos Co., Ltd.	1	1 1/2-1 1/2	102,268	5	5/-	Calcutta Tramways Co., Ltd.	5	91-92
£10,000	5	9d	British Aluminium Co. 7% Cum. Pref.	5	5-5 1/2	£350,000	Stk	4 1/2%	Do. 4 1/2% 1st Deb. Stk., Red.	100	107-109
£300,000	Stk	5%	Do. 5% 1st Mort. Deb. Stk. Rd.	100	98-102 1/2	480,000	1	6d.	Cape Electric Tramways, Ltd.	1	1-1 1/2
100,000	5	4	British Insulated & Helsby Cables Ltd., Ord.	5	6 1/2-7 1/2	40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5% Cum. Pref.	5	44-54
100,000	5	3/-	Do. 6% Cum. Pref.	5	5 1/2-6 1/2	£300,000	100	4%	Do. 4% 1st Mort. Debs.	100	101-103
£500,000	Stk	4 1/2%	Do. 4 1/2% 1st Mort. Deb. Stk. Rd.	100	103-106	£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101-103*
£200,000	Stk	4 1/2%	British Thomson-Houston Co., Ltd. 4 1/2% 1st Mort. Deb. Stk. Red.	100	98-100	60,000	10	6/-	Dublin United Trams Co. (1896) Ltd., Ord.	10	134-144
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 8% Pref.	5	2 1/2-2 5/8	59,987	10	6/-	Do. 6% Pref.	10	15-16
£616,853	Stk	4%	Do. 4% Mort. Deb. Stk. Red.	100	85-89	30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	22-23
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord.	2	1 1/2-1 3/4	£150,000	Stk	4%	Do. 4% Deb. Stock.	100	88-88
150,000	2	2 1/2	Do. 6% Pref.	2	1 1/2-1 3/4	125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	93-101
£125,000	Stk	4 1/2%	Do. 4 1/2% Perp. 1st Deb. Stk.	100	93-97	£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	100-103
£125,000	Stk	4 1/2%	Do. 4 1/2% Perp. 2nd Deb. Stk.	100	77-80	£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Rd.	100	103-105
£125,000	Stk	4 1/2%	Callender's Cable & Constn. Ltd. Ord.	5	11-12 1/2	314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	32-32
35,000	5	5/-	Do. 5% Cum. Pref.	5	5 1/2-6 1/2	500,000	1	6d.	Do. 5% Cum. Pref.	1	1-1 1/2
40,000	5	2/6	Do. 4 1/2% 1st Mort. Deb. Stk. Red.	100	109-111	£350,000	Stk	4 1/2%	Do. 4 1/2% Deb. Stock, Red.	100	106-108
£200,000	Stk	4 1/2%	Crompton & Co., Ltd.	3	13-14	50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	4-14
85,000	3	1/6	Do. 5% 1st Mort. Reg. Debs.	100	94-99 1/2	110,923	8	2/3	North Metropolitan Tramways Co., Do. 3 1/2% Mort. Debs.	100	93-98
£100,000	—	5%	Dick, Kerr & Co., Ltd., Ord.	5	8 1/2-9	£150,000	100	3 1/2%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red.	100	104-107
52,000	5	10/-	Do. 6% Cum. Pref.	5	6-6 1/2	£196,200	Stk	5%	Potteries Elec. Traction Co., Ltd., Ord.	10	92-94
61,000	5	8/-	Do. 4 1/2% Deb. Stock, Red.	100	106-108	24,500	10	5/-	Do. 5% Cum. Pref.	10	92-93
£300,000	Stk	4 1/2%	Doulton & Co., Ltd., 5% Cum. Pref.	1	13-12	£220,000	Stk	4 1/2%	Do. 4 1/2% Deb. Stk., Red.	100	103-106
233,334	1	6d.	Do. 1st Mort. 4% Free. Deb. Stk.	100	107-110						
£233,334	Stk	4 1/2%	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	12-14						
99,261	5	1/6	Do. "A" Shares Nos. 01-017,139	5	2-2 1/2						
17,139	5	2/6	Do. 4% Deb. Stock Red.	100	85-90						
£314,023	Stk	4%	Do. 5% Second Deb. Stk. Red.	100	93-97						
£100,000	Stk	5%	Electric Construction Co. Ltd.	2	8-8 1/2						
112,100	2	1 1/2	Do. 7% Cumulative Pref.	2	1 1/2-2 1/2						
31,390	2	2/3	Do. 4% Perp. 1st Mt. Deb. Stk.	100	92-95						
£200,000	Stk	4%	Evered and Co., Ltd.	10	10-12						
10,248	10	7/6	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	94-10						
25,000	10	5/-	Do. 4% 1st Mt. Deb. Stk., Red.	100	96-100						
£200,000	Stk	4%	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12-13						
35,000	5	5/-	Do. 4 1/2% Cum. Pref.	5	5 1/2-5 1/2						
95,000	5	2/3	Do. 4 1/2% Mt. Deb. Stk. Red.	100	109-111						
£50,000	Stk	4 1/2%	India Rubber, Gutta Percha & Telegraph Works Co., Ltd., 1st Mort. Deb. Red.	10	15 1/2-16 1/2						
50,000	10	5/-	Parker, Thos. Ltd.	10	64-7						
£300,000	100	4%	Scott (Ernest) & Mountain, Ltd., Ord.	1	17 1/8-17 1/9						
7,500	10	—	Telegraph Construction and Maintenance Co., Ltd.	12	33-35						
100,000	1	3%	Do. 4% Deb. Bonds	100	102-104						
37,350	12	12/-									
£150,000	100	4%									

III.—ELECTRIC TRACTION.

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices.	Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices
120,000	5	3/6	Anglo-Argentine Trams Co., Ltd., Ord.	5	85-87	7,500	10	14/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord.	10	121-123
260,007	5	2/6	Do. 5% Cum. Pf.	5	54-58	7,500	10	4/6	Do. 4 1/2% Cum. Pref.	10	104-106
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888	100	141-144	7,500	10	6/-	Do. 6% Cum. Second Pf.	10	111-124
20,000	10	12/-	Barcelona Trams Co., Ltd., Ord.	10	13 1/2-14 1/2	£70,000	Stk	4 1/2%	Do. 4 1/2% Deb. Stock Red.	100	107-109
10,000	10	5/-	Do. 5% Cum. Pf. Shares	10	94-10	14,000	5	3/6	Bromley (Kent) Elec. Lt. & Pr. Co. Ltd.	5	52-53
£46,800	100	5%	Do. 5% Debs., Red.	100	98-101	£50,000	Stk	4 1/2%	Do. do. 4 1/2% 1st Deb. Stk. Red.	100	102-105*
£191,326	Stk	4 1/2%	Do. 4 1/2% Red. Deb. Stk.	100	97-102	27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd., Ord.	5	94-98
75,006	1	—	Bath Elec. Trams, Ltd., Pf. Or.	1	7-10	12,493	5	3/6	Do. 7% Cum. Pref. Shares.	5	92-94
59,394	1	11-1d	Do. 5% Cum. Pf.	1	18-18 1/2	60,000	5	5/-	Calcutta Elec. Sup. Cor. Ltd., Ord.	5	9-9 1/2
77,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord.	5	1-1 1/2	£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. S. K.	100	105-108
75,000	5	2/6	Do. 6% Cum. Pf.	100	95-95 1/2	70,000	5	2/6	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord.	5	7-7 1/2
£425,000	Stk	4 1/2%	Do. 4 1/2% 1st Deb. Stk. Red.	100	124-127*	80,000	5	2/3	Do. do. 4 1/2% Cum. Pref.	5	54-56
£200,000	Stk	6%	Brit. Columbia Elec. Ry. Co., Ltd., Def. Ord. Stock	100	111-114	£350,000	Stk	4%	Do. do. 4% Deb. Stk., Red.	100	108-105
133,301	10	6/-	rit. Electric Traction, Ltd., Ord.	10	98-100	41,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	51-62
156,437	10	6/-	Do. 6% Cum. Pref.	10	11-11 1/2	£150,000	Stk	4 1/2%	Do. do. 4 1/2% Deb. Stk., Red.	100	110-112
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk.	100	121-123	70,595	10	7/-	City of London El. Lightg. Co., Ltd., O.	10	12-12 1/2
£250,000	Stk	4 1/2%	Do. 4% 2nd Deb. Stk. Red.	100	99-100*	40,000	10	6/-	Do. 6% Cum. Pref.	10	182-184
100,000	6	2/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3 1/2-3 1/2	£400,000	Stk	5%	Do. 5% Deb. Stk., Red.	100	124-128
40,500	5	3/-	Do. "A" 6% Cum. Pref.	5	5 1/2-5 1/2	£300,000	Stk	4 1/2%	Do. 4 1/2% 2nd Deb. Stk. Red.	100	104-106
27,000	5	3/-	Do. "B" do.	5	5-5 1/2	30,000	10	6/-	Do. 6% Cum. Pref.	10	94-104
						£400,000	Stk	4 1/2%	Do. 4 1/2% Deb. Stk., Red.	100	111-114
						70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	54-6
						70,000	5	3/-	Do. 6% Cum. Pref.	5	6-6 1/2
						£300,000	Stk	4 1/2%	Do. 4 1/2% 1st Mort. Deb. Stk. Red.	100	109-111
						£50,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	85-90
						19,000	5	2	Folkestone Elec. Supply Co., Ltd., O.	5	52-54
						£50,000	Stk	4 1/2%	Do. 4 1/2% 1st Deb. Stk., Red.	100	100-103
						15,000	10	—	Havana Electricity Co., Ltd.	10	9-10
						13,000	5	5/-	Hove Elec. Lighting Co., Ltd., Ord.	5	84-88
						£50,000	Stk	4 1/2%	Isle of Wight Electric Light & Power Co., Ltd. 4 1/2% Deb. Stock, Red.	100	99-102*
						150,000	1	—	Kalgoorlie Electric Power & Lighting Corp., Ltd., 6% Cum. Pref.	1	13-14
						21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord.	5	114-124

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—Contd.

TELEGRAPHS AND TELEPHONES.—Contd.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	98-101
111,000	3	1 93	London Elec. Supply Corp., Ltd., Ord.	3	1 24
60,000	5	3/-	Do. 6% Pref.	5	5 54
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	39 10 1/2
100,000	10	5/-	Metropolitan Elec. Sup. Co., Ltd., Or.	10	10 10 1/2
76,121	5	2 3	Do. 4 1/2% Cum. Pref.	5	5 54
220,000	Stk	4 1/2%	Do. 4 1/2% 1st Mort. Db. Stk., Red.	100	100-113
250,000	Stk	3 1/2%	Do. 3 1/2% Mort. Deb. Stk., Red.	100	97 90
£250,000	—	1 1/2%	Midland Elec. Corp. for Power Distribution, Ltd., 4 1/2% 1st Mort. Deb.	100	101-103 1/2
10,852	10	8/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14 15
£59,000	100	4%	Do. 4% 1st Mort. Debs.	100	38 100
16,500	5	2 6	Oxford Electric Co. Ltd., Ord.	5	6 6 1/2
£50,000	Stk	4%	Do. 4% Debenture Stk., Red.	100	100-102
£84,700	100	4 1/2%	Royal Elec. Co. (of Montreal) 4 1/2% 20-yr. 1st Mort. Deb.	100	100-103
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	104-14 1/2
20,000	5	3/6	Do. 7% Pref.	5	4 1/2
£150,000	Stk	3 1/2%	Do. 3 1/2% Deben. Stock, Red	100	98-100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2 2 1/2
£50,000	Stk	4%	Do. 4% Debenture Stk., Red.	100	76-80
65,000	5	4/-	South London Elec. Sup. Co., Ltd., O.	5	3 1/2 4
100,000	1	—	South Metropolitan Elec. Light & Power Co., Ltd. Ord.	1	1 1/2 1 1/2
50,000	1	8 1/2d.	Do. 7% Cum. Pref.	1	1 1/2 1 1/2
£100,000	Stk	4 1/2%	Do. 4 1/2% 1st Deb. Stock, Red.	100	105 108
50,000	5	2 6	Urban Electric Supply Co., Ltd., O.	5	4 1/2-4 1/2
30,000	5	2 6	Do. 5% Cum. Pref.	5	5 5 1/2
£200,000	Stk	4 1/2%	Do. 4 1/2% 1st Mort. Deb. Stk., Red.	100	104-106
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	123 12 1/2
28,151	5	2/6	Do. 5% Cum. Pref.	5	8 6 1/2

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
58,321	10	6d.	W. India & Panama Teleg. Co., Ltd., Or.	10	1 1/2-1 1/2
34,563	10	6/-	Do. 6% Cum. 1st. Pref.	10	8 1/2-9
4,669	10	6/-	Do. 6% Cum. 2nd Pref.	10	7 1/2-7 1/2
£80,000	100	5/-	Do. 5% Deb.	100	101-10 1/2
207,930	10	3/-	Western Telegraph Co., Ltd.	10	14 1/2-14 1/2
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101-10 1/2
518,945	Stk	4%	Do. 4% Deb. Stock, Red.	100	102 1/2-10 1/2

VI.—SHIPPING COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 6 1/2% Cum. Pref.	10	9 1/2-9 1/2
£325,000	Stk	4 1/2%	Do. 4 1/2% Red. 1st Mort. Deb. Stk.	100	99-101 1/2
£672,900	Stk	4 1/2%	British & African Ste. Nav. (1900) Ltd., 4 1/2% 1st Mort. Deb. Stk., Red.	100	98-100
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5 1/2% Cum. Pref.	10	5 1/2-6 1/2
£600,000	Stk	4 1/2%	Do. 4 1/2% 1st Mort. Deb. Stk.	100	89-92
£750,000	Stk	4 1/2%	Clan Line Steamers, Ltd., 4 1/2% Deb. Stk., Red.	100	99-101
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000	20	14 1/2-15
40,000	20	4/-	Do. Nos. 60,001-100,000	10	6 1/2-7
£464,430	Stk	4 1/2%	Elder Dempster Shipping, Ltd., 4 1/2% 1st Mort. Deb. Stk.	100	102-104 1/2
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord.	1	1 1/2-1 1/2
25,328	7 1/2	4/7	Gen. Steam Navigation Co., Ltd., Ord.	7 1/2	5-5 1/2
36,758	8	4/9 1/2	Do. Non-Cum. 6% Pref.	8	5 1/2-9
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk., Red.	100	98-100
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	2-2 1/2
40,000	5	2/9	Do. 5 1/2% Cum. Pref.	5	2 1/2-3 1/2
£200,000	Stk	4 1/2%	Do. 4 1/2% 1st Mt. Deb. Stk., Red.	100	87-90
141,500	10	5/-	Leyland (Fredk.), & Co. (1900), Ltd., 5% Cum. Pref.	10	6-6 1/2
£1,160,000	Stk	5%	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref.	100	127-130
£1,160,000	Stk	19%	Do. do. Deferred	100	245-248
15,000	100	30/-	Royal Mail Steam Packet Co. Ord.	60	45-47
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref.	5	4 1/2-5 1/2
141,841	10	4/-	Do. "B" Ord.	5	3 1/2-4 1/2
24,000	10	4/6	Do. do. Co., Ltd., Ord.	10	8 1/2-9*
£1,008,894	Stk	4%	Do. 4 1/2% Cum. Pref.	10	104-11
			Do. 4% Debenture Stk., Red.	100	100-102

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£34,800	100	4%	African Direct Tel. Co., Ltd., 4% Mt. Debs. (Series A), Red.	100	99-102
25,000	10	—	Amazon Telegraph Co., Ltd.	10	4-4 1/2
£763,580	Stk	14/-	Anglo-American Tel. Co., Ltd., Ord.	100	60-62
£3,118,210	Stk	28/-	Do. 6% Preferred Ordinary	100	107 1/2-108 1/2
£3,118,210	Stk	2/-	Do. Deferred Ordinary	100	15 1/2-16 1/2
44,000	5	5/-	Cable Telephone Co., Ltd.	5	7 1/2-7 1/2
£15,000,000	£100	\$2	Commercial Cable Co., Capital Stk.	£100	96-98
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	8 1/2-9 1/2
16,000	10	5/10	Cuba Submarine Tel. Co., Ltd., Ord.	10	17-18*
6,000	10	10/-	Do. 10% Preference	10	8 1/2-9 1/2
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	9 1/2-9 1/2
£30,000	50	4 1/2%	Do. 10% Cum. Preference	50	100-109 1/2
60,710	20	4/-	Direct U.S. Cable Co., Ltd.	20	18 1/2-14
£85,800	100	4 1/2%	Direct West India Cable Co., Ltd., 4 1/2% Reg. Debs.	100	100-102
£300,000	100	4%	East. & S. African, Ltd., 4% Mt. Dbs.	100	99-101
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)	25	99 1/2-101 1/2
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd.	10	14 1/2-15
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	106-10 1/2
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord.	100	143-146
£2,000,000	Stk	17/6	Do. 3% Pref.	100	89-91
£1,886,814	Stk	4%	Do. 4% Mort. Deb.	100	106-108*
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen)	10	35 1/2-36 1/2
£59,700	100	4 1/2%	Halifax and Bermudas Cable Co., Ltd., 4 1/2% 1st Mort. Debs. Red.	100	100-102
17,000	25	12/6	Indo-European Tele. Co., Ltd.	25	55-57*
72,680	1	9 1/2d.	Monte Video Telephone Co., Ltd., O.	1	1 1/2-1 1/2
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	111 1/2-112 1/2
£1,966,667	Stk	5%	Do. Deferred	100	106 1/2-107 1/2
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5 1/2-5 1/2
£2,000,000	Stk	3 1/2%	Do. 3 1/2% Deb. Stk., Red.	100	88-100
£684,938	Stk	4%	Do. 4% do. do.	100	104-106
179,313	1	7 1/2d.	Oriental Telephone & Elec. Co., Ltd.	1	1 1/2-1 1/2
50,000	1	7 1/2d.	Do. 6% Cum. Pref.	1	1 1/2-1 1/2
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red.	100	100-103
11,839	5	4/-	Reuter's Telegram Co., Ltd.	5	7 1/2-8 1/2
59,000	5	3/-	United River Plate Tele. Co., Ltd.	5	7-7 1/2
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 1/2-5 1/2
£179,947	Stk	5%	Do. 5% Deb. Stock, Red.	100	110-112
15,809	10	5/-	W. African Telegraph Co., Ltd.	10	10-10 1/2
£30,008	2 1/2	—	West Coast of America, Ltd.	2 1/2	15-15 1/2
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	100-102

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
60,000	1	9 1/2d.	Chadburn's Ship. Tele. Ltd., Ord.	1	1 1/2-1 1/2
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	123-128
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord.	10	25-27
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14-17
183,538	1	6 3/4d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	1 1/2-2 1/2
66,462	1	8 1/4d.	Do. do. Nos. 1-66,462	1	1 1/2-2 1/2
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord.	1	1 1/2-1 1/2
135,000	1	7 1/4d.	Do. 6% Cum. Pref.	1	1 1/2-1 1/2

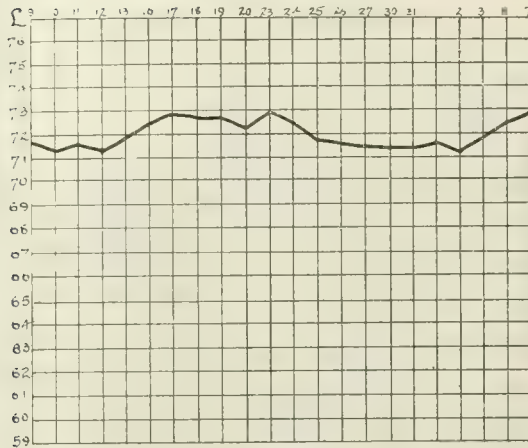
RAILWAY CARRIAGE & WAGON COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
10,000	10	7/6	Birm. Railway-Car. & Wagon, L.	10	25-26
			Do. Second Issue 1-8,739	4	9 1/2-9 1/2
8,739	10	3/-	Do. Cum. Pref. 6% 1-10,000	10	13-14 1/2
10,000	10	6/-	Do. do. 6% Cum. Pref.	7	10-10 1/2
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ltd.	7	10 1/2-10 1/2
			A, 1-29,861 & 49,751-50,000		
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 1/2-4 1/2
14,567	10	1/3	Lancashire Wagon, Ord.	2	2-2 1/2
4,150	10	5%	Do. do.	10	10 1/2-10 1/2
781,808	1	9d.	Metropolitan Amalgamated Rail. Carriage & Wagon, Ltd., 1-784,808	1	4 1/2-4 1/2
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	24/-24 1/2
235,000	1	7 1/4d.	Do. Cum. B Pref. 6% 1-235,000	1	27/-28/-
20,000	20	20/-	Midland Rail.-Car & Wagon, Ltd., 1-20,000	10	20 1/2-21 1/2

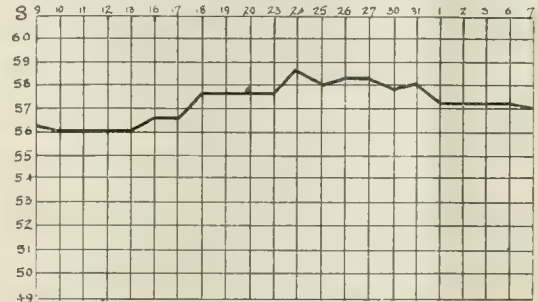
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM OCTOBER 9TH TO NOVEMBER 7TH, 1905.

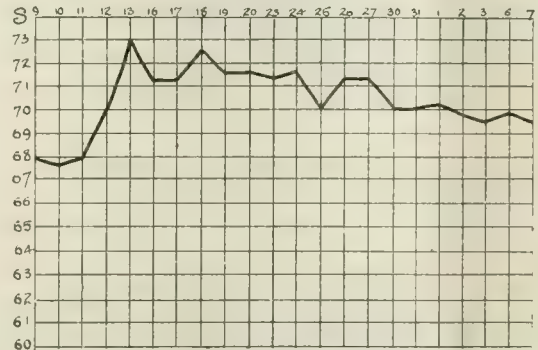
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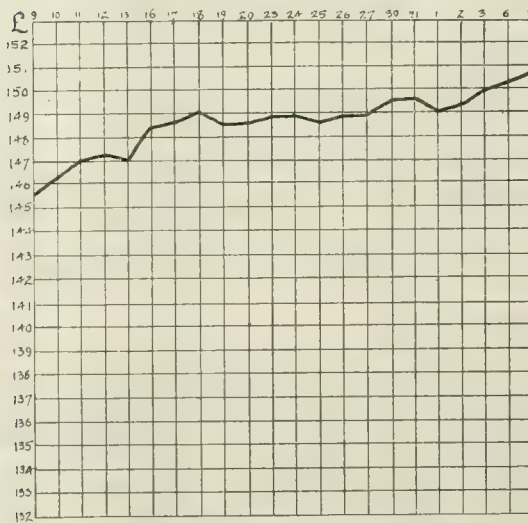
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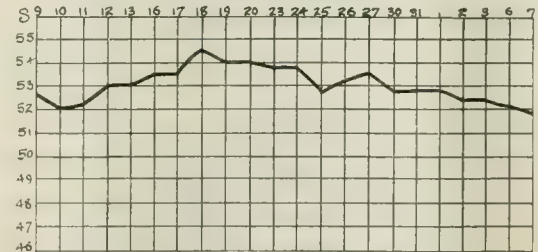
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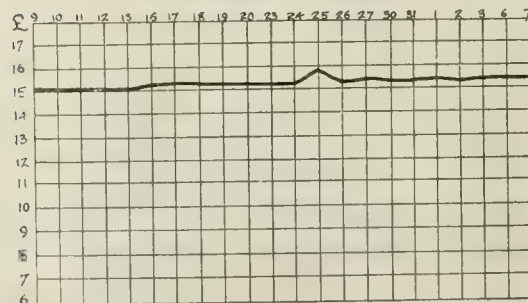
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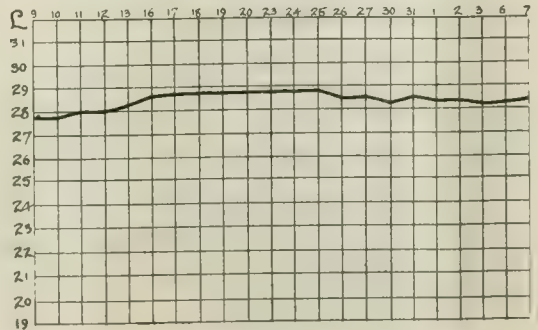
CLEVELAND.



ENGLISH LEAD.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, November 8th, 1905.

THE Copper market has shown evidence of slackness during the past week. At one time prices were inclined to sag a little, but the position was so generally strong that no sharp break in quotations could be anticipated, and indeed, the market now shows renewed strength. It is evident that the reduced stocks of standard Copper have facilitated controlling operations, and that the big holders are able to keep a tight hand on the position. On the improved tone there has been a tendency for bears to cover, and the market closes firm with a fair amount of business at £72 12s. 6d, cash, and £71 10s. three months.

The Tin section remains strong notwithstanding the fact that Eastern advices have been somewhat erratic in tone. There is a well-sustained demand for all positions, and quotations have again hardened, near delivery being dealt in at over £150 per ton. In spite of the high price of the metal the position would appear to be decidedly sound. The visible supply has reached a fresh low record, and the consumptive demand continues to be good, so that with no probable material increase in output the present high price of the metal appears likely to be maintained. Yesterdays quotations were, fine foreign £150 10s. cash, and £149 17s. 6d. three months.

The Lead market remains very firm, near delivery being still quoted at over £15, buyers, and the metal appears to be very strongly held.

A slight reaction in the Spelter market has to be recorded, consequent upon imports of American metal, the probability of which was referred to in a recent issue. For near dates parcels are, however, still very scarce at £28 5s. for ordinaries, but forward metal is quoted at a considerable discount on this price.

The Pig-Iron warrant market has been weaker, many operators for the rise having taken fright and thrown their commitments on the markets. The process of realisation having been completed, some recovery followed, but Cleveland is now no better than 52s. Hematite shared the weakness of Cleveland, but is also firmer at the time of writing, being quoted 69s. 6d. buyers, one month.

IRON, STEEL, PIG- IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

Steel:		£	s.	d.
 Dalzell	Siemens' Steel Plates, Marine Boiler Quality ..	8	2	6
 Steel	" " " Land " " ..	8	2	6
 Steel	" " Steel Bars, Boiler Quality	8	5	0
 Dalzell	Siemens' Steel Plates, Ship Quality Plates.....	7	2	6
 Steel	" " Bars " "	7	15	0
 Steel	" " Angles	6	15	0

Manufactured Iron:

Bars—Dalzell	7	2	6
" Best	7	12	6
" " Horseshoe	7	12	6
" Angle	7	2	6
" Best Angle	7	12	6
" Best Best	8	2	6
" Extra Best	8	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

(Glasgow  Steel)	£	s.	d.	
Steel Angles	6	10	0	per ton.
Steel Ship Plates	6	17	6	"
Steel Bars, Ship Quality	7	10	0	"
Glasgow   Steel.				
Steel Bars, Boiler Quality	8	0	0	"
Steel Land Boiler Plates	7	7	6	"
Steel Marine Boiler Plates	7	7	6	"

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phoenix Iron-works, Coatbridge, N.B., quote:—

Bars—Phoenix	£	s.	d.
Best	7	5	0
" Best Best	8	5	0
" Extra Best	8	15	0
" Best Horse Shoe	7	15	0
" Extra B.H.S.	8	15	0
" Extra Best Cable	9	5	0
" Rivet	7	5	0
" Best Scrap Rivet	8	5	0

Angles—Phoenix	£ s. d.
Best	7 5 0
Extra Best	8 5 0

Gas Tube Hoops—Phoenix Best	7 15 0
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Plates—Phoenix	—
Best Boiler	8 10 0
Best Best Boiler	9 0 0
Extra Best Boiler	10 0 0

Boiler Tube Strips—Phoenix	9 0 0
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All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote (Commission extra).

Pig Iron :	No. 1.	No. 3.
	£ s. d.	£ s. d.
Coltness, f.a.s. Glasgow	3 16 0	3 6 0
Gartsberrie	3 8 6	3 3 6
Summerlee	3 11 0	3 6 0
Carnbroe	3 5 0	3 2 0
Langloan	3 10 0	3 5 0
Calder	3 7 6	3 2 6
Clyde	3 8 0	3 3 0
Glengarnock, f.o.b. Ardrossan	3 8 0	3 3 0
Eglinton	3 5 6	3 0 0
Dalmellington, „ Ayr	—	3 0 0
Shotts	3 7 6	3 2 6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, at works:—

	£ s. d.
W.W.  Bars	7 5 0
W.W. Best Bars	7 12 6
W.W. Best Best	8 5 0
W.W. Best Best Best	8 15 0
W.W. Best Shoe	7 12 6
Thornaby 	8 12 6
Thornaby Best	9 2 6
Thornaby Best Best	10 2 6
Whitwell Special Admiralty Cable	10 12 6
Special Chain Iron	9 12 6
Tube and Nail Strips	7 7 6
W.W.  Angle Iron	7 7 6
W.W. Best Angle Iron	7 15 0
Tee Iron, to 8-inches United	8 5 0

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, announce that in the present uncertain state of the market, their quotations are temporarily withdrawn

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

	Singles 20 G 96in. by 36in. per ton.	Doubles 21 G to 24 G 96in. by 86in. per ton.
Black Sheets	£ s. d.	£ s. d.
“Vale”	10 10 0	11 0 0
“Shield”	11 0 0	12 0 0
“Severn”	12 0 0	13 0 0
“Baldwin Wilden B.”	13 0 0	14 0 0
Charcoal	17 0 0	18 0 0
Best Charcoal	19 0 0	20 0 0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:

	£ s. d.	£ s. d.
No. 3 Lead	14 0 0	15 0 0
S.V. Lead	15 10 0	16 10 0
No. 3 Terne	15 10 0	16 10 0
S.V. Terne	17 0 0	18 0 0

	Singles 20 G to 108 by 36in. per ton.	Doubles 21 to 24 G to 96 by 36in. per ton.
Tinned Sheets:	£ s. d.	£ s. d.

Best Coke (Finish)	29 0 0	30 10 0
Charcoal (Finish)	31 0 0	32 10 0
Extra	33 0 0	34 10 0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for. Tin Plates, “Cookley, K” Best Charcoal, £1 7s. 0d. per box. Extreme sizes in Tin and Patent Coated specially quoted for. Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands. At works.

Galvanized Corrugated Sheets:

“Phoenix” Brand, 24 G., f.o.b. London, in Bundles	£ s. d.
“Blackwall” Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	13 5 0 per ton.
	15 10 0 „

Galvanized Working Up-Sheets:

24 G., f.o.b. London, in Bundles	£ s. d.
	14 5 0 per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£ s. d.
Crown Bars	7 5 0 per ton.
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares)	7 15 0 „
Angles	7 10 0 „
Best	8 0 0 „
T’s	7 15 0 „
Best	8 5 0 „
Best Shoe Iron	8 15 0 „
Rivet Iron	8 15 0 „
Best Rivet (Special)	10 0 0 „
Cable	10 0 0 „
Screwing	9 0 0 „

	£	s.	d.	
Best Turning	8	15	0	per ton.
„ Plating	9	0	0	„
Best Best	10	0	0	„
Treble Best	11	0	0	„
Plates	8	5	0	„
Best Plates	8	15	0	„
„ Boiler Plates	9	5	0	„
„ Best Boiler Plates	10	5	0	„
Treble Best Boiler Plates	12	15	0	„

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon.,
quote "Star" brand patent wrought nails steel nails, &c.

Discounts—

42½ per cent off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

37½ per cent. off 3½ inch to 7-inch strong rose and 10dy and 20dy. pound.

37½ per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 10/6 per cwt.

4 cwt. lots and upwards 10/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch to 6-inch basis—

2 tons 9/3 per cwt.

4 cwt. lots 9/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £8 per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E.C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla,
quote:—

	Per Box.	f.o.b.	Wales.
	£	s.	d.
Coke Tin-plates.			
C 18½ by 14 124s. 110 lb. "BV"	0	13	3
C 20 by 10 225s. 155 „ "Jumbo"	0	18	9
C 20 by 14 112s. 108 „ "Lydbrook"	0	13	0
C 28 by 20 112s. 216 „ "Lydbrook"	1	6	3

Charcoal Tinplates:

C 20 by 14 112s. 108 lb. "Allaway" 0 13 9

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:	£	s.	d.	
Blooms	at 4	2	0	per ton.
Billets	at 4	4	0	„
Sheet Bars	at 4	6	0	„

Finished Steel:

Bars	at 5	15	0	per ton.
Angles	at 5	16	0	„
Tees	at 5	19	0	„
Joists	at 5	0	0	„
Fencing Standards	at 5	15	0	„
Shoeing Bars	at 5	19	0	„
Tyre Bars	at 5	19	0	„
Half-Round Bars	at 6	3	0	„
Heavy Rails	at 5	10	0	„
Light Rails	at 5	10	0	„

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.	£	s.	
English Ingots, f.o.b.						
Dis. 1½% & 1%	153	0	0	to 153	10	0 per ton
English Bars, f.o.b.						
Dis. 1½% & 1%	154	0	0	to 154	10	0 ..
Straits G.M.B., cash						
Warehouse, Net	150	10	0	to 150	12	6 ..
Straits G.M.B., 3 months, Warehouse, Net	150	0	0	to 150	2	6 ..
Australian, Mt. Bischoff, Warehouse, Net	151	0	0	to 151	10	0 ..

COPPER.

Copper :	£	s.	d.	£	s.	d.
Standard G.M.B., cash Warehouse, Net	72	5	0	to 72	10	0 per ton.
Standard G.M.B., 3 months, Warehouse, Net.....	71	5	0	to 71	10	0 „
English, Tough, Cake & Ingot, Warehouses, Net	76	10	0	to 77	0	0 „
English, Best Select, Warehouse Net	77	0	0	to 77	10	0 „
English, Sheets and Sheathing, f.o.b., Dis. 2½%	85	0	0	to 86	0	0 „
English, Sheets for India, f.o.b., Dis. 2½%	80	0	0	to 80	10	0 „
Electro, Warehouse, Net .	76	15	0	to 77	0	0 „
Ore, ex. ship	0	13	3	to 0	14	3 per unit
Regulus, Matte and Precipitate, ex ship.	0	14	3	to 0	14	9 „

YELLOW METAL.

Yellow Metal:	£	s.	d.
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%	0	0	6½ per lb
Sheathing „ „ „	0	0	7 „

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	28	5	0	to	28	7	6	per ton.
Blende of 50 % Net	8	0	0	to	8	7	6	„
Calamine, Net	8	9	0	to	8	10	0	„

LEAD

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis 2½%	15	7	6	to	15	10	0	per ton.
Spanish, ex ship, Dis. 2½%	15	2	6	to	15	5	0	„
Lead Ore of 70 %, Net.....	7	10	0	to	8	0	0	

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½% ..	49	0	0	to	50	0	0	per ton
Ore, 50 %, ex ship, Dis. 2½% ..	12	10	0	to	15	0	0	„
Crude, ex ship, Dis. 2½% ..	25	0	0	to	30	0	0	„

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net.....	7	5	0	per flask
Italian " " " " " " " " " " " "	7	2	6	"

COAL.**LEICESTERSHIRE.**

The Nailstone Colliery Company, Leicester,
quote. Price per Ton at Pit of 20 Cwt., with $\frac{1}{2}$ Cwt. per
Ton for wastage —

Upper Main Seam.	s. d.
Main Coal	6 6
Best Hard Steam (hand picked, as used by the Railway Companies)	5 6
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6 0
Fine Slack	0 6
Terms, net cash on 10th of month following delivery.	

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston
quote as follows, per ton at pit:

Kilburn Coal:	s. d.
Best London Brights	9 3
Large Nuts ($1\frac{1}{2}$ to $3\frac{1}{2}$)	9 0
Small Nuts ($\frac{3}{4}$ to $1\frac{1}{2}$)	6 0
Peas ($\frac{3}{4}$ to $\frac{3}{8}$)	5 0
Rough Slack	4 0
Slack	3 6
Smudge	2 0

Rutland Coal:

Brights (4 to 8)	7 6
Large Nuts (2 to 4)	7 0
Slack	3 6
Hand-picked Hards	7 6
Hard Cobbles	6 3

The Clay Cross Company's Collieries, Clay Cross,
near Chesterfield, quote:—

	per ton at pit.
Best Main Coal	10 6
Best Silkstone	10 0
Best House Coal	8 6
Best House Nuts	8 0
Treble Screened Cobbles	7 9
Best Cobbles	7 3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham,
quote per ton at pit:—

Digby Coal:

STEAM.	s. d.
Best Hand Picked Hard	8 6
Steam Hard	7 3
Hard Nuts	6 6

Gedling Colliery.

HIGH HAZEL (or Ashless House Coal).

London Brights, 4 to 8 in. cube	11 0
Bright Cobbles (Hand Picked)	10 6
Large Nuts, 2 to 4 in. cube	10 0
Small Nuts, 1 to 2 in. cube	6 3
Pea Nuts, $\frac{3}{4}$ to 1 in. cube	5 0

STEAM.—TOP HARD.

Best Hard	8 6
Hard Steam	7 6
Cobbles	6 3

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square,
Manchester, quote:

Acids:	£	s.	d.
Oxalic	0	0	2 $\frac{1}{2}$ per lb
Picric, Crystals	0	0	11. "
Tartaric	0	0	10 $\frac{3}{4}$ "

Acetate of Lime:	£	s.	d.
Brown at Manchester net	8	10	0 per ton.
Grey	11	15	0 "
Alumina: Alum, Lump, loose	5	5	0 "
" " in casks	5	7	6 "
" " Ground, in bags	5	15	0 "
Sulphate of Alumina, 14%	4	10	0 "

Ammonia: Carbonate	0	0	3 $\frac{3}{4}$ per lb.
Muriate Grey f.o.b. Liverpool	24	15	0 per ton.
Sal-ammoniac, Lump, 1sts, del'd U.K.	42	0	0 "
" " 2nds, ...	40	0	0 "
Sulphate	13	0	0 "
Arsenic: Best White Powdered	15	0	0 "
Bleaching Powder, 35%	4	7	6 "
Borax: British Refined Crystal	13	0	0 "

Coal Tar Products:

Benzole, 50 90 %	0	0	8 $\frac{1}{2}$ per gal
" " 90%	0	0	9 "
Carbolic Acid Crystals, 34 35° C.	0	0	5 $\frac{1}{2}$ per lb
" " 39/40° C.	0	0	5 $\frac{1}{2}$ "
" " Liquid, 97 99°	0	0	9 per gal.
" " Crude, 62 $\frac{1}{2}$ % at 60° F.			
" " f.o.b.			
Creosote, ordinary good liquid	0	0	17 $\frac{1}{2}$ "
Naphtha, Crude, 20 % at 120° C.	0	0	3 $\frac{1}{2}$ "
" " Solvent, 90 % at 160° C. f.o.b.	0	0	10 $\frac{1}{2}$ "
" " 95 % at 160° C. "	0	0	11 $\frac{1}{2}$ "
" " 90 % at 190° C. "	0	1	0 "
" " Rectified, flash point over 73° F. f.o.b.	0	1	0 "
" " Rectified, flash point over 100° F. f.o.b.	0	1	1 "
Naphthalene, all qualities.			
Pitch			
" " f.a.s. Manchester.			
Copperas: Green, in bulk	0	12	6 "
" " barrels f.o.b. L'pool	1	18	6 "
" " Cake	1	1	6 "
Copper: Sulphate	22	15	0 "

Cyanides: 98%, minimum ... f.o.b. net 0 0 7 $\frac{1}{2}$ per lb.

Lead: Acetate (Sugar) White, English	27	10	0 per ton.
" " Foreign c.i.f. U.K.	24	0	0 "
" " Grey	22	15	0 "
" " Brown at Manchester	17	5	0 "
Nitrate	25	10	0 "
Litharge, Flake	17	0	0 "
" " Powder	17	10	0 "
Red Lead, Genuine, c.i.f. London less 5%	16	10	0 "
White " " Dry " "	17	10	0 "

Naphtha (Wood): Miscible, 60 o.p. 0 2 4 per gal.
Solvent 0 | 2 | 7 " |

Potash: Bichromate... delivered England... ..	0	0	3 per lb
Carbonate, 90/92 % ... c.i.f. Hull ..	17	15	0 per ton.
Caustic, 75/80 %	19	5	0 "
Chlorate	0	0	3 $\frac{1}{2}$ per lb.
Montreal	31	10	0 per ton.
Prussiate Yellow	0	0	4 $\frac{1}{2}$ per lb

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When patents have been communicated the names of the communicators are printed in *italics*.

- 19235. S. Cowper-Coles, London.** Sept. 23rd.—Improvements in the production of iron castings.
- 19275. E. Batault, Switzerland.** Sept. 23rd.—Improvements in apparatus for starting explosion motors. (Date applied for Sept. 26th, 1904.)
- 19276. E. Ruud, London.** Sept. 23rd.—Improvements in storage water heaters. (Date applied for March 27th, 1905.)
- 19279. The Wolseley Tool and Motor Car Company, Ltd., and A. A. Remington, Wolverhampton.** Sept. 23rd.—Improvements for use in starting multiple cylinder and double-acting cylinder internal combustion engines.
- 19280. G. M. Schebler, London.** Sept. 23rd.—Improvements in and relating to carburetters.
- 19104. J. Grice, London.** Sept. 23rd.—Improvements in circular saw-machines.
- 21467. O. Howl and W. J. Tranter, Birmingham.** Oct. 23rd, 1905.—Improvements in steam generators.
- 21480. H. C. L. Holden, London.** Oct. 23rd, 1905.—Improvements in electrical ignition devices for internal combustion engines.
- 21508. Morgan and Co., Ltd., and D. H. Whitehead, London.** Oct. 23rd, 1905.—Improvements in change-speed gear for motor-cars and the like.
- 21559. J. W. Weeks, London.** Oct. 23rd, 1905.—Improvements in gas pressure regulators.
- 21566. F. Reichenbach, London.** Oct. 23rd, 1905.—Improvements in or relating to the supply of gas to gas engines.
- 21568. A. H. Atteridge, London.** Oct. 23rd, 1905.—A new or improved rotary engine.
- 21592. J. W. Burne, Cumberland.** Oct. 24th, 1905.—A two-speed gear and free engine for motor cycles, tri-cars and the like.
- 21616. E. Barnes, Birmingham.** Oct. 24th, 1905.—Improvements in pumps applicable to forced lubrication.
- 21639. P. H. Adams, London.** Oct. 24th, 1905.—Improvements in centrifugal concentrators.
- 21643. J. Kritzler, Liverpool.** Oct. 24th, 1905.—An improved method and means for insulating the sparking plugs of internal combustion engines.
- 21650. W. H. Peck, London.** Oct. 24th, 1905.—Improvements in centrifugal ore separator.
- 21665. A. A. Longuemare, London.** Oct. 24th, 1905.—Improvements in or relating to carburetters for explosion engines.
- 21674. The Warwick Machinery Co., Ltd., London.** Oct. 24th, 1905.—Improvements in elastic fluid turbines.
- 21704. R. McGown, Manchester.** Oct. 25th, 1905.—New or improved starting mechanism for internal combustion engines or engines using oil or gaseous fuel.
- 21710. W. E. Rowlands and P. Rowlands, Liverpool.** Oct. 25th, 1905.—Improvements relating to internal combustion engines.
- 21711. W. E. Rowlands and P. Rowlands, Liverpool.** Oct. 25th, 1905.—Improvements relating to internal combustion engines.
- 21721. L. V. Atkinson, Surrey.** Oct. 25th, 1905.—Improvements in the treatment of refractory ores.
- 21738. W. Meer, London.** Oct. 25th, 1905.—Improvements in and relating to valves.
- 21780. C. H. Walmsley, Manchester.** Oct. 26th, 1905.—Improvements in carburetters for internal combustion motors.
- 21791. J. H. Mogg, Junior, C. H. Pym, and E. J. Witcombe, Bristol.** Oct. 26th, 1905.—Improvements in motor lubricating pumps.
- 21796. M. H. Robinson, London.** Oct. 26th, 1905.—Improvements in steam boilers.
- 21820. J. Cowan, London.** Oct. 26th, 1905.—Improvements relating to superheaters.
- 21845. The Honourable C. A. Parsons, and G. G. Stoney, London.** Oct. 26th, 1905.—Improvements in and relating to steam turbines.
- 21853. W. Graaff, London.** Oct. 26th, 1905.—Improvements in chemical fire extinguishers.
- 21872. J. W. B. Stokes, Glasgow.** Oct. 27th, 1905.—An improved gas calorimeter.
- 21908. O. Schwade, London.** Oct. 27th, 1905.—Improvements in and relating to valve gear for engines.
- 21914. H. Dansey.** Oct. 27th, 1905.—Improvements in or connected with carburetters for use in connection with internal combustion engines.
- 21934. J. I. Thornycroft and Co., Ltd., and J. Douglas, London.** Oct. 27th, 1905.—Improvements in propellers.
- 21943. H. Sack, London.** Oct. 27th, 1905.—Improvements in hydraulic shearing machines.
- 21965. W. Rowbotham, Birmingham.** Oct. 28th, 1905.—Improvements in and relating to power generators.
- 21966. U. S. Lynde, Manchester.** Oct. 28th, 1905.—Improvements in carburetters and the like.
- 21976. A. J. Grant, Liverpool.** Oct. 28th, 1905.—Improvements in or connected with indicating and counting the speeds of rotation of engines.
- 21985. G. H. C. Lumsden, Glasgow.** Oct. 28th, 1905.—Improvements in speed indicators.

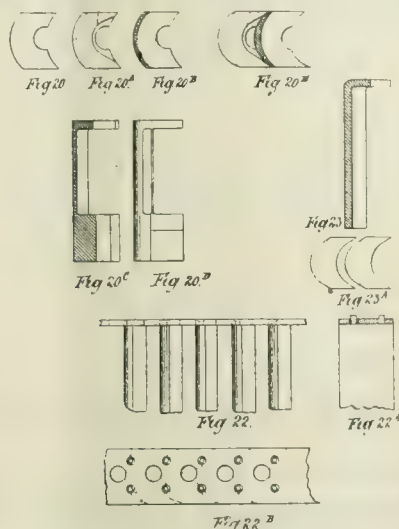
RECENT SPECIFICATIONS.

IMPROVEMENTS IN AND RELATING TO TURBINES OPERATED BY EXPANSIBLE FLUIDS.

Bellis and Morcom, Ltd., and A. Jude, Birmingham, September 21st, 1905.—This invention relates to improvements in the construction of steam or gaseous fluid turbines of the impulse type, and comprises the following features:—

(A). Economical methods of manufacture of the several elements and various improved devices for their assembly and rigid coherence.

(B). A system of ventilation of the chambers between the vanes adapted to minimise the influence on the



stream of working fluid of friction by those portions of the surface which take no effective part in the propulsion of the motor.

(C). A combination of the Pelton wheel type of turbines, for the initial stages of the operation of obtaining mechanical energy from the high-pressure fluid, with the axial flow type in the later stages of energy abstraction from the fluid, and—

(D). Subsidiary means for the efficient and economical construction and working of elastic fluid turbines.

Figs. 20 to 23a show methods of constructing and assembling the vanes of an axial flow type of turbine, which has advantages over the former described type in the later stages of the fluid expansion.

In vanes so constructed and proportioned, the width of the stream of fluid which is receivable between the entrance edges of two consecutive vanes (the width being measured in a direction at right angles to the tangents of the curve at the entrance edges) is less than the width available for the passage of the stream at the central section of the vanes. To avoid a tendency for the stream to expand in approaching the central section and fill up the whole section of flow requiring a subsequent contraction when escaping from between the vanes, which extraneous expansion and contraction would tend to the dissipation of energy over and above the additional loss which would in that case be due to the friction on the back of the succeeding

ne, apertures are provided for the ventilation of the passage by cutting away a portion of the shrouding, as shown by the aperture in fig. 20a and fig. 20c, and also by the aperture formed in the shank, together with an aperture formed in the securing ring.

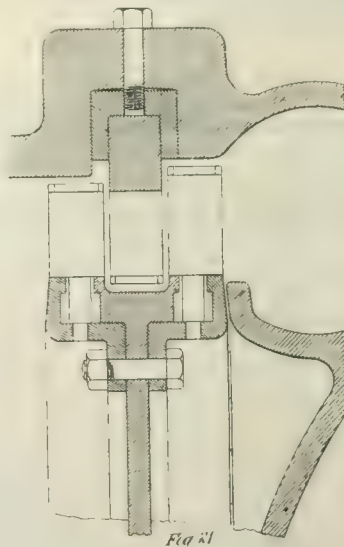
By ventilating the spaces between the vanes in this or some equivalent manner, the boundary of the stream of fluid on the concave side of its curved path, i.e., on the side away from the face of the vane on which the stream is pressing, will be rendered independent of the shape of the back of the adjacent vanes, causing the fluid action to approximate to that which occurs in turbines of the Pelton wheel type.

Fig. 20e shows an alternative method of thinning the vanes at their entrance and exit edges.

In this invention the revolving vanes are retained in place by the insertion of one shoulder underneath the projecting ledge, formed in the wheel, whilst the other shoulder is yoked by a junk-ring. A similar junk-ring retains the second set of the revolving vanes. Both junk-rings are secured by bolts, the rings fitting accurately within the rim of the wheel so as to minimise the stress on the bolts.

The fixed intermediate vanes fit tightly in a holding block, which is secured to the casing by screw bolts. The cavity in the casing is made slightly concave, so that on drawing the block tightly against the bottom of the cavity, the sides tend to pinch the shanks of the fixed blades. To assist the clasp ing action above described, the sides of the shanks are sometimes slightly dovetailed.

Fig. 22 is a side elevation, fig. 22a is a transverse section, and fig. 22b is a plan. The shrouding band



is perforated with rivet holes, through which lugs formed on the vanes are inserted and riveted. At the back of each vane a ventilating hole is bored.

If the vane is stamped out of plate, as would be possible according to the sectional elevation in fig. 23, and secured in one of the ordinary ways to the rotating wheel, or fixed abutment, the shrouding may stop short of the back of the next consecutive vane, as shown in fig. 23a, and the intervening space would serve as a ventilation aperture.

NEW PUBLICATIONS.

"RADIO-ACTIVITY."

By E. Rutherford, D.Sc., F.R.S. F.R.S.C. Second Edition. Cambridge University Press. 12s. 6d. net.

The second edition of Professor Rutherford's admirable treatise follows very closely upon the first, for scarcely a year has elapsed since the original issue came under our notice. The salient features work are already widely known and accepted as authoritative, but the researches carried out during the past twelve months have necessitated the revision of the entire volume. The three new chapters which have been added, possibly constitute the most important fresh feature; they include a detailed account of the theory of successive changes and its application to the analysis of the series of transformations which occur in radium, thorium and actinium. The disintegration theory, remarks the writer, which was put forward in the first edition as an explanation of radio-active phenomena, has in these later researches proved to be a most powerful and valuable method of analysing the connection between the series of substances which arise from the transformation of the radio-elements. A considerable amount of new data has been added relating to the nature and properties of the radiations and the emanations. In the second chapter a short account is given of the magnetic field produced by an ion in motion, of the action of an external magnetic and electric field upon it and the determination of the velocity and mass of the particles constituting the cathode stream. In the appendices will be found valuable matter dealing with the α -rays and of the chemical constitution of the various radio-active minerals, the localities in which the latter are found, and their probable geologic age. The index adds to the utility of the volume, which is well furnished with diagrams.

BOOKS RECEIVED.

"Natural and Induced Draught." By John W. Cobv: reprinted from the Journal of the Society of Chemical Industry. (Vacher and Sons.) Professor A. Smithells, who occupied the chair at the meeting of the Yorkshire section when the paper was read, characterised it as a very valuable contribution to an important subject. The author considers that the treatment given to this question has often been somewhat one-sided, and at the outset he invites us to look dispassionately at the facts and ascertain as far as we can, the limits within which a condemnation of that venerable antique the chimney stack is justified. Much attention is given to the theoretical side of the matter, and the paper has several useful tables and diagrams. "Electric Mining Rules and Data." (W. T. Glover and Co., Ltd.) This admirably illustrated booklet combines in a handy form some regulations and data that may be useful to those interested in the application of electricity to mining work. The size is convenient, the type clear, and we anticipate a large demand for this very practical compilation.—"Machine Shop Companion." By Wallace Bentley, M.I. Mech.E. (Chapman and Hall.) This book is for practical engineers and mechanics. Bound in flexible cloth covers, suitable for the pocket, it contains useful notes, rules, and tables for everyday workshop use, including an illustrated chapter on screw-cutting, with list of change wheels, notes on the lathe, boring, drilling, planing, shaping, slotting, milling, grinding, and gear-cutting machines, etc.—"Journal of the Association of Engineering Societies." Vol. XXXV. No. 1. (F. Brooks, Boston.) The contents of this number include papers on grade-crossing problems in St. Louis,

forces due to eccentric weights attached to rolling wheels, and the work of the Hydrographic branch of the United States Geological Survey in New England.—"The Dolomite Formation of the Transvaal." (Esson and Perkins, Johannesburg), being a paper read at the meeting of the British Association at Johannesburg by C. B. Horwood, F.G.S., A.R.S.M., A.M. Inst. C.E.

NEW CATALOGUES.

The Leeds Forge Company, Ltd.—One of the finest productions of the year is undoubtedly the album which has been produced by the above firm to illustrate their pressed steel railway rolling stock. Views and a description of the works are followed by others representing the advantages of pressed steel construction, including low tare weight, economy of upkeep, low cost of re-erection and strength. Pressed steel plates, carriage underframes, wagon underframes, carriage bogies, and wagon bogies are successively dealt with, after which we arrive at a very instructive section devoted to high-capacity wagons, a subject which has received the very special attention of the firm. The illustrations include a 20-ton coal wagon (four-wheeled), 30-ton coal wagon (bogie), covered goods wagon (bogie), and a 15-ton coal and merchandise wagon. The section includes a comparison of bogie and four-wheeled wagons, showing in some cases a saving of as much as 40 per cent. in tare weight, and 56 per cent. in train length. Self-discharging wagons, dealing with coal at the rate of one ton per second are then described, after which we arrive at examples of rolling stock for light railways, for which pressed steel is particularly well adapted. The remaining pages are concerned with tests of pressed steel underframes and bogies, various types of wagons, carriage underframes, and bogies. The extraordinary variety and extent of the contents of this album seem the more remarkable when it is remembered that it represents the activities of a single department only.

Hobson, Houghton and Co., Sheffield, forward copies of their new general catalogue and twist drill catalogue just received from the printer. In the former, some very useful information is given on the subject of the tool, and other steel manufactured at the Don Works. Among the special brands of tool steel described, we note that the firm's "Choice," "Fearless," and "Koh-i-noor" steels are produced in five different tempers: No. 1 temper, suitable for turning, planing and slotting tools, drills and small cutters (will not weld); No. 2, suitable for large turning tools and drills, mill picks, taps, rimers, and circular cutters (will not weld); No. 3, suitable for punches, screwing dies, shear blades (will weld with care); No. 4, suitable for cold chisels, cold setts, large shear blades, large punches and taps (will weld easily); No. 5, suitable for hot setts, boiler snaps, stamping dies, welding steel for plane irons, smiths' tools, such as flatteners, fullers, swages and sett hammers (will weld easily). The pages devoted to standard files and rasps are well illustrated, and are arranged in a manner calculated to save time. Picks, hammers, blacksmiths' tools, circular saws and band saws, are among other features prominently described. Skilful tabulation has enabled the firm to include a surprising amount of information in their new 14-page catalogue of twist drills, reamers, chucks, etc. Attention is called to a new boiler-makers' reamer. All these tools are hardened by a special process.

PAGE'S WEEKLY Miscellaneous

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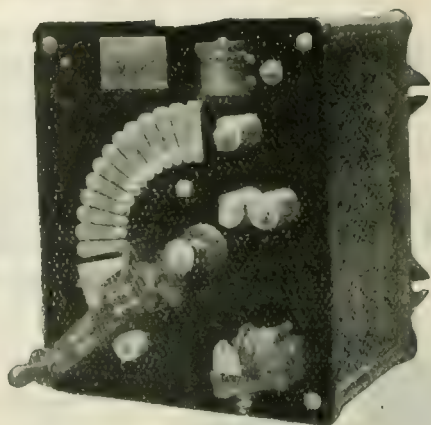
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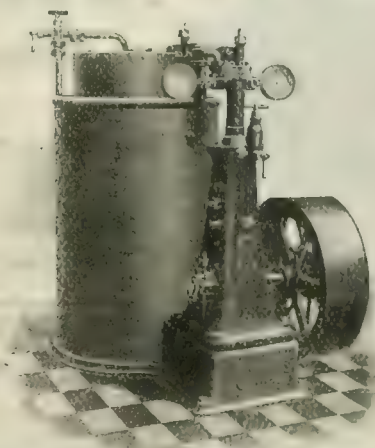


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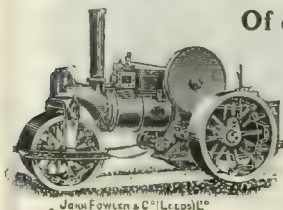
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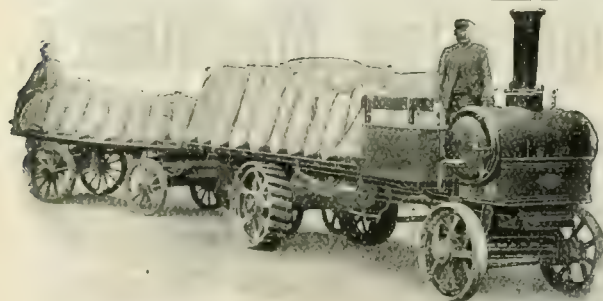
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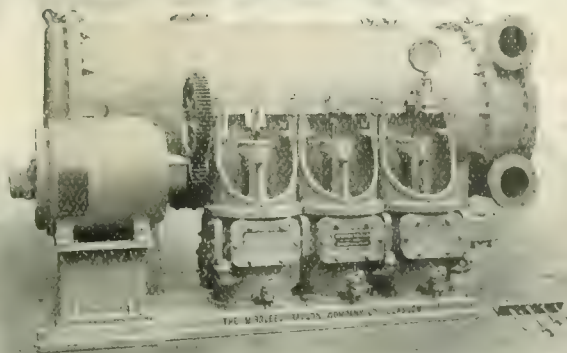


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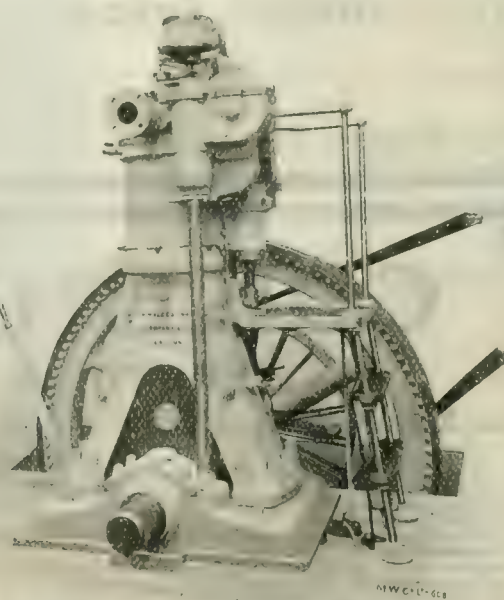
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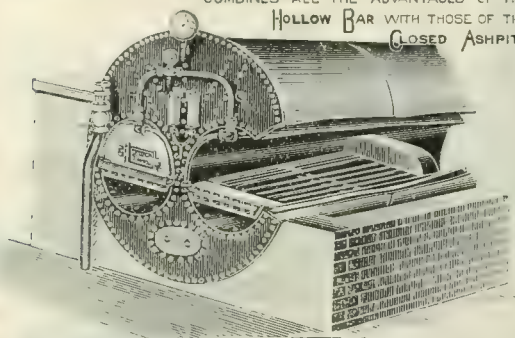
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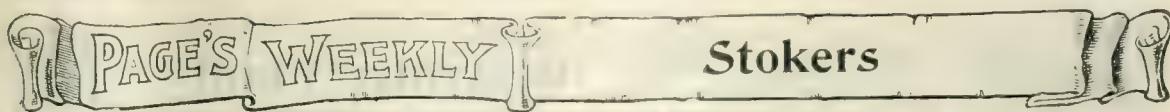
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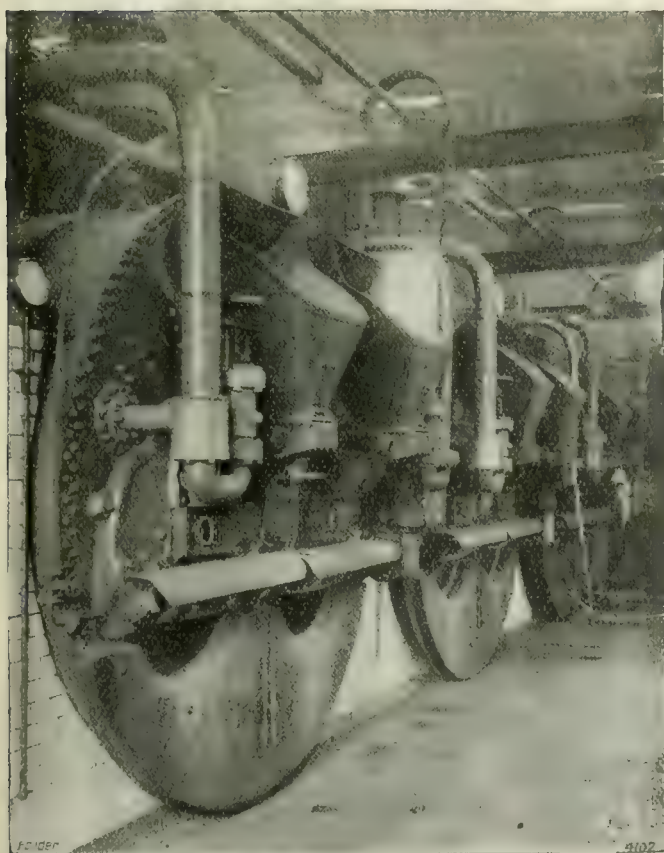




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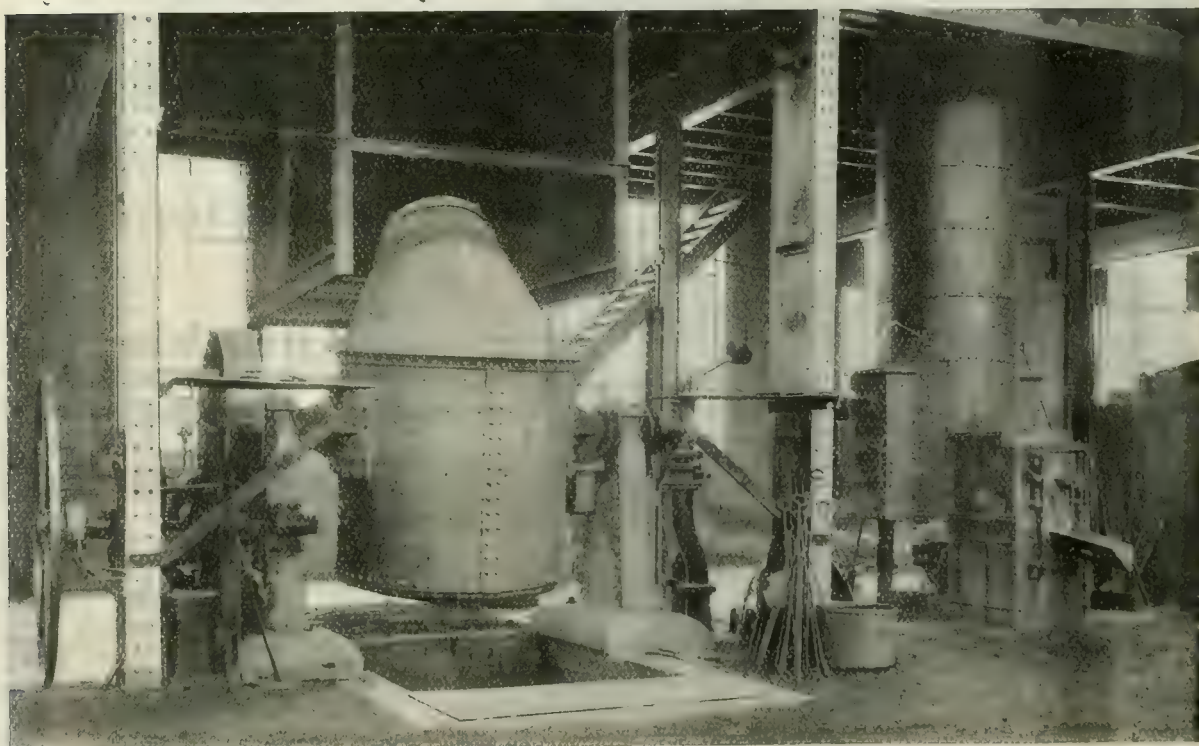
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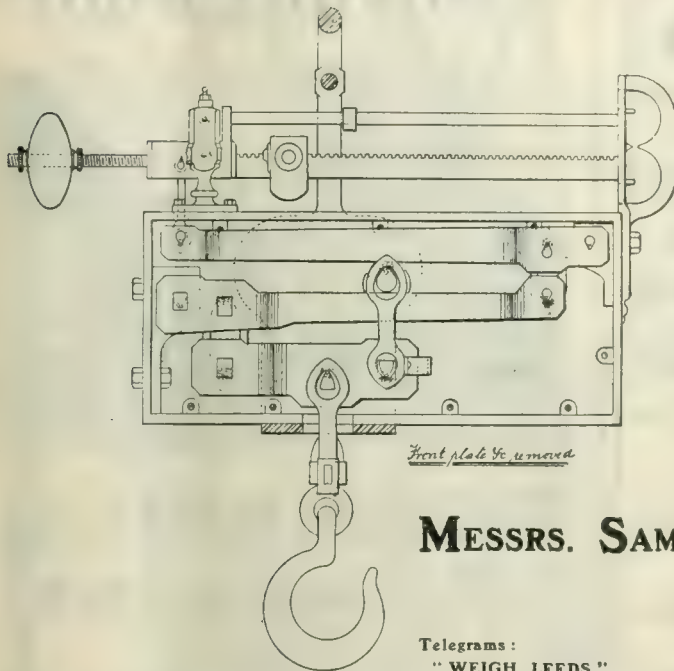
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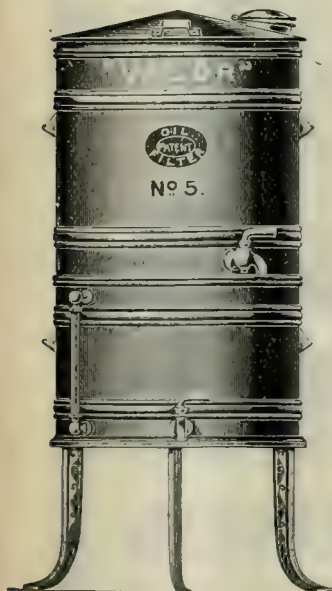
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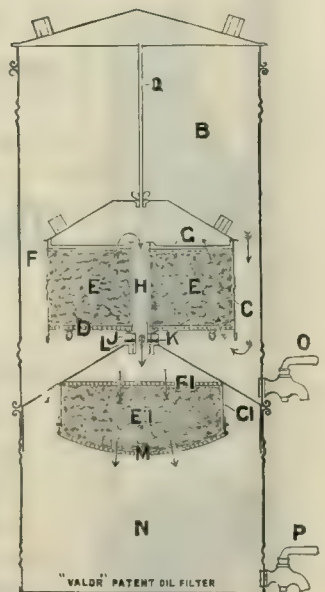
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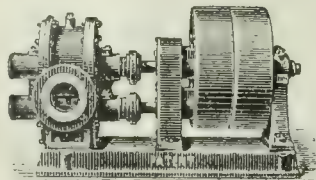
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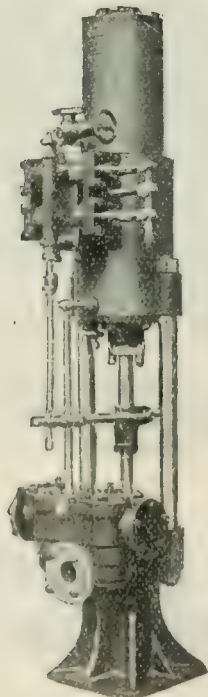
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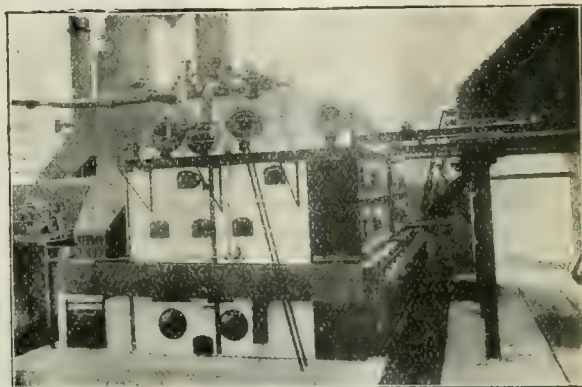
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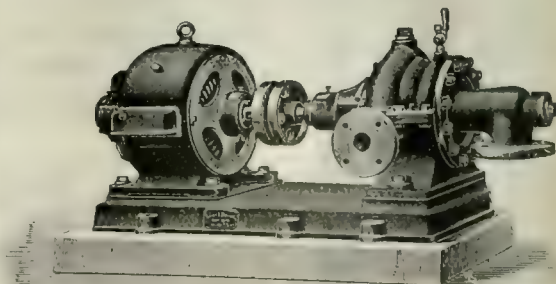
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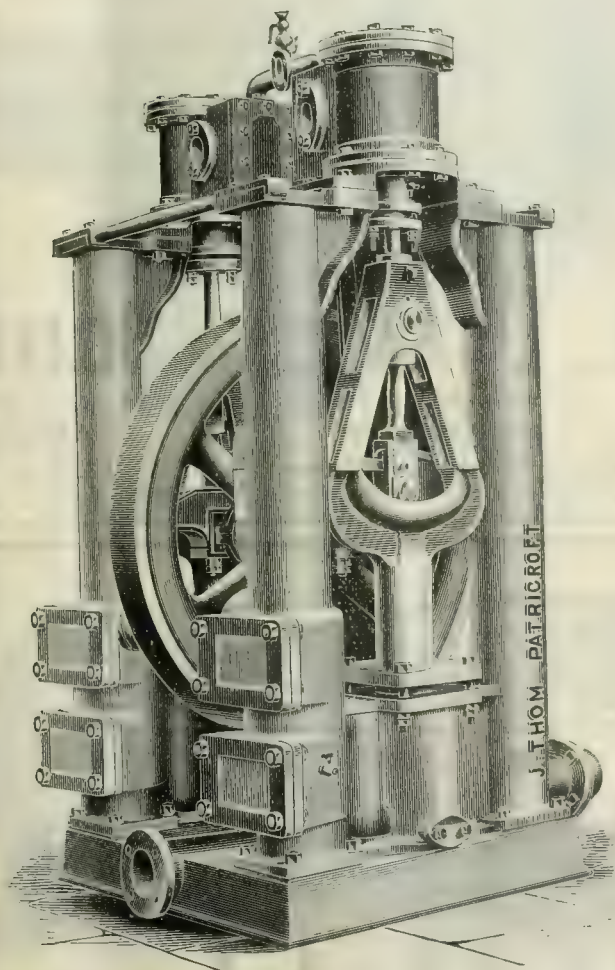


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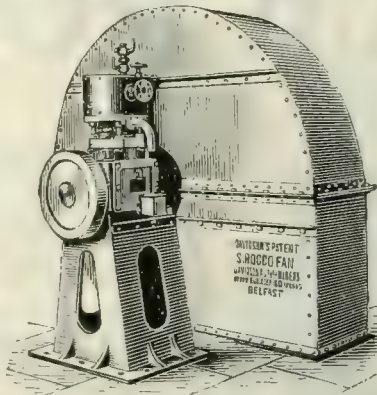
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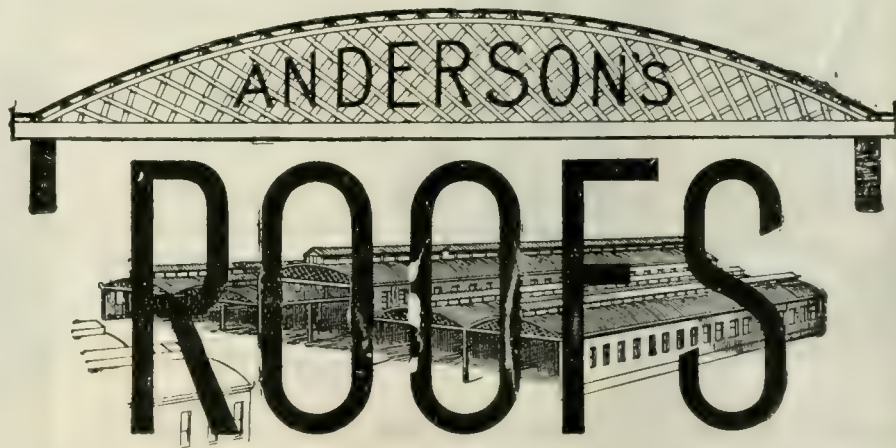
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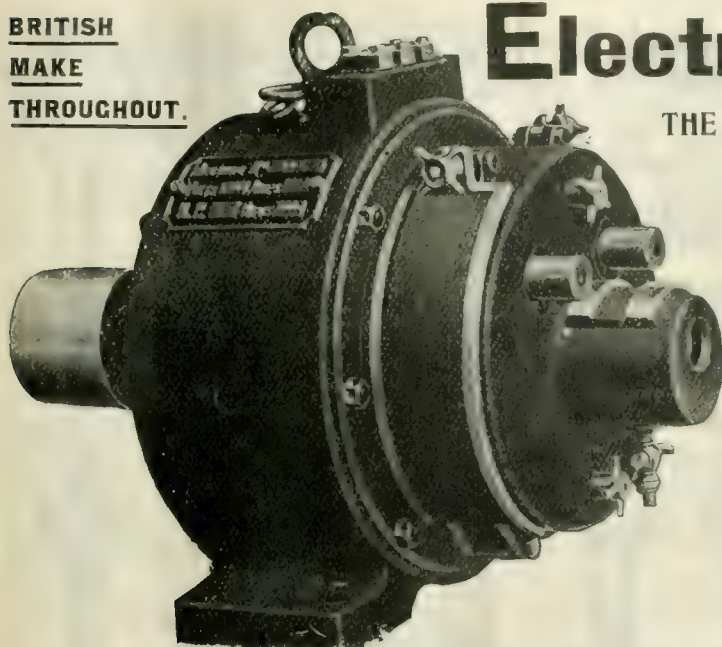
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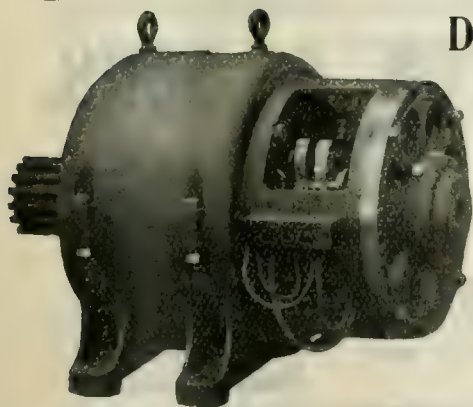
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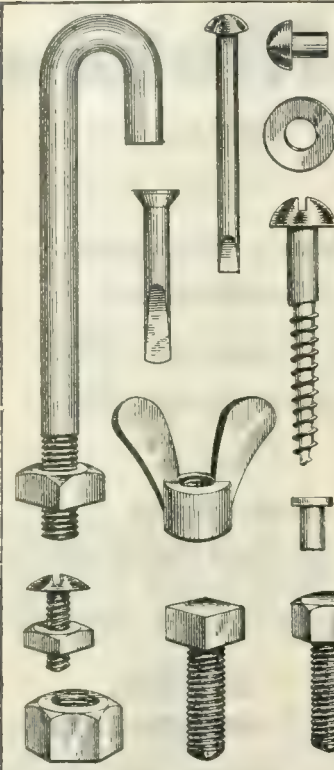
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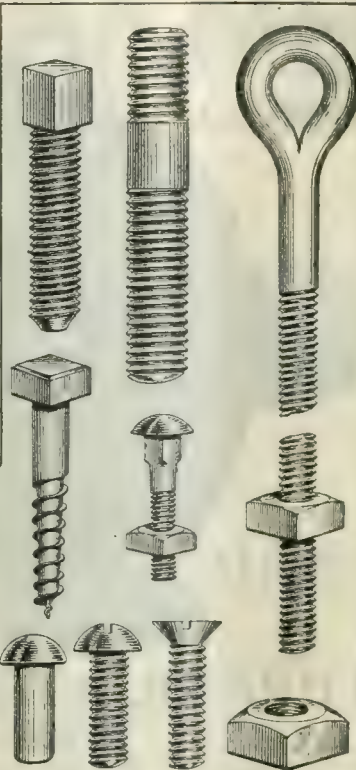
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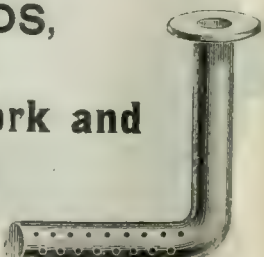
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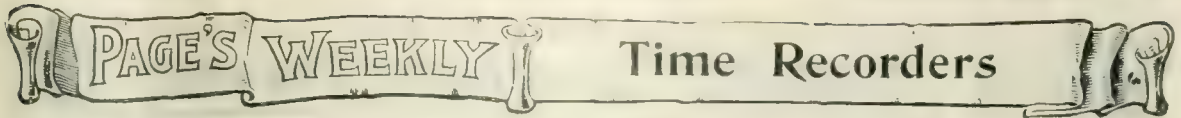
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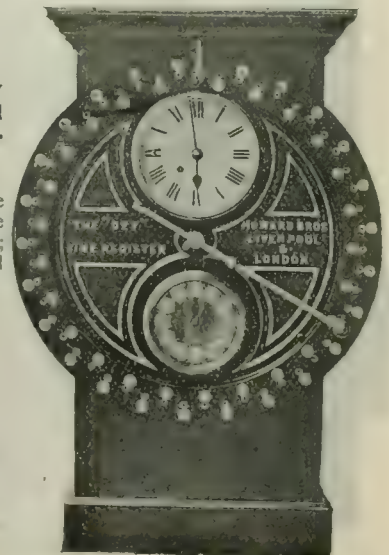
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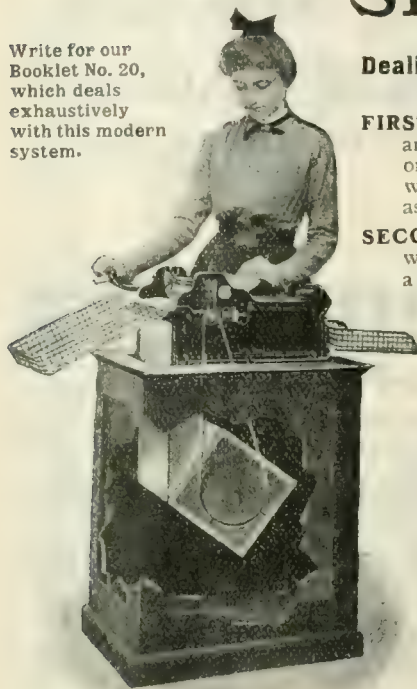
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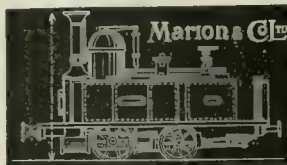
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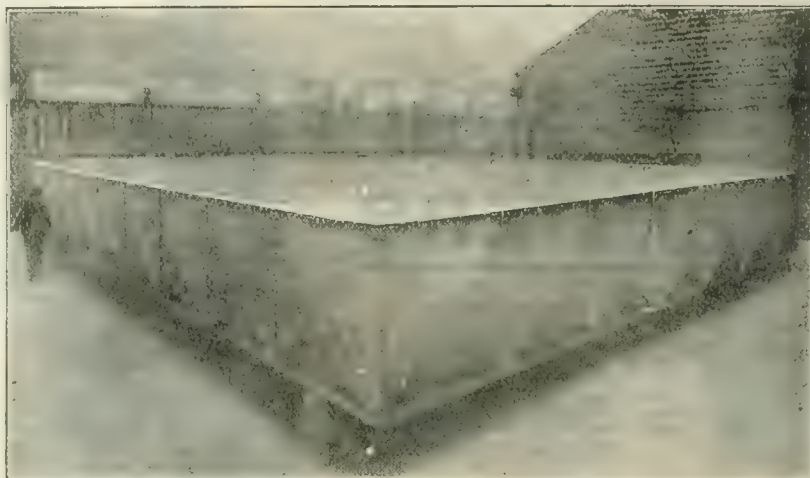
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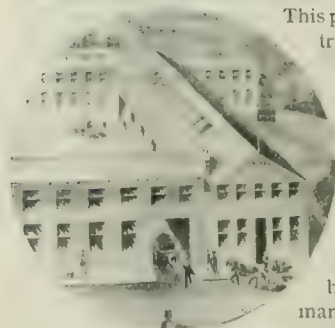
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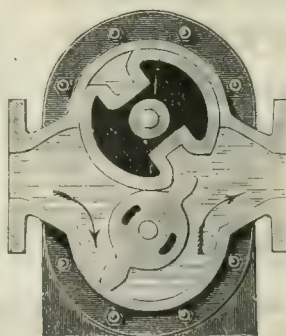


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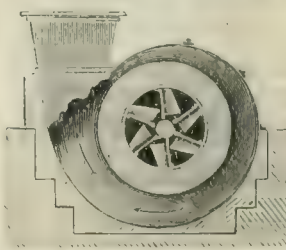
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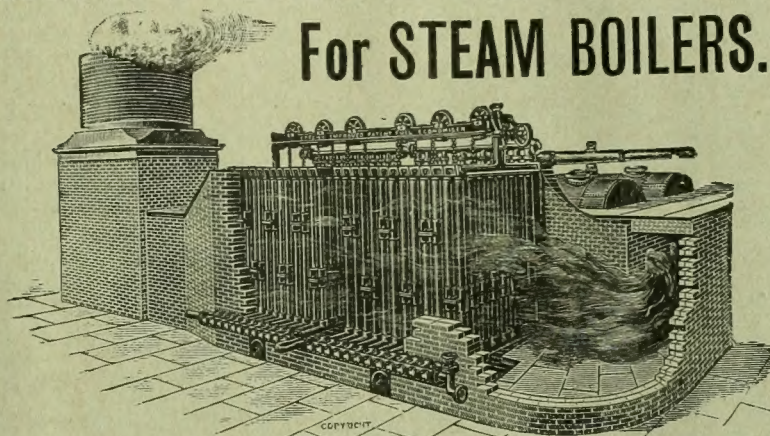
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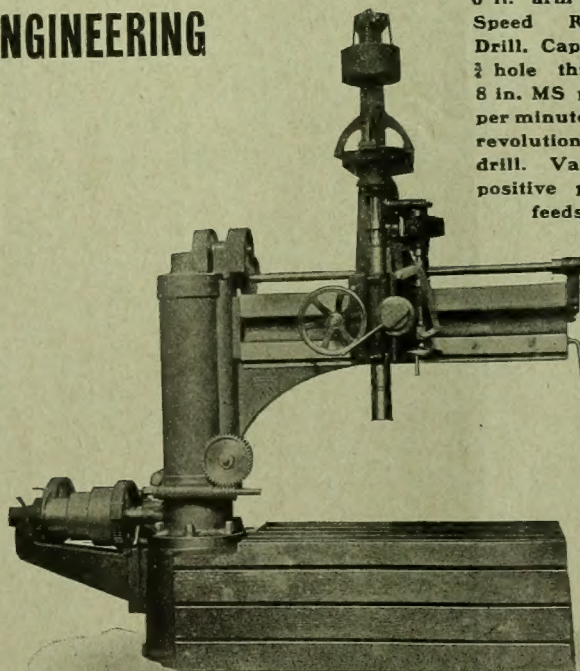
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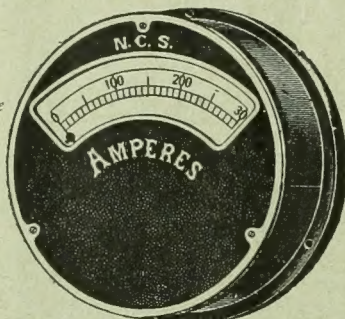
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